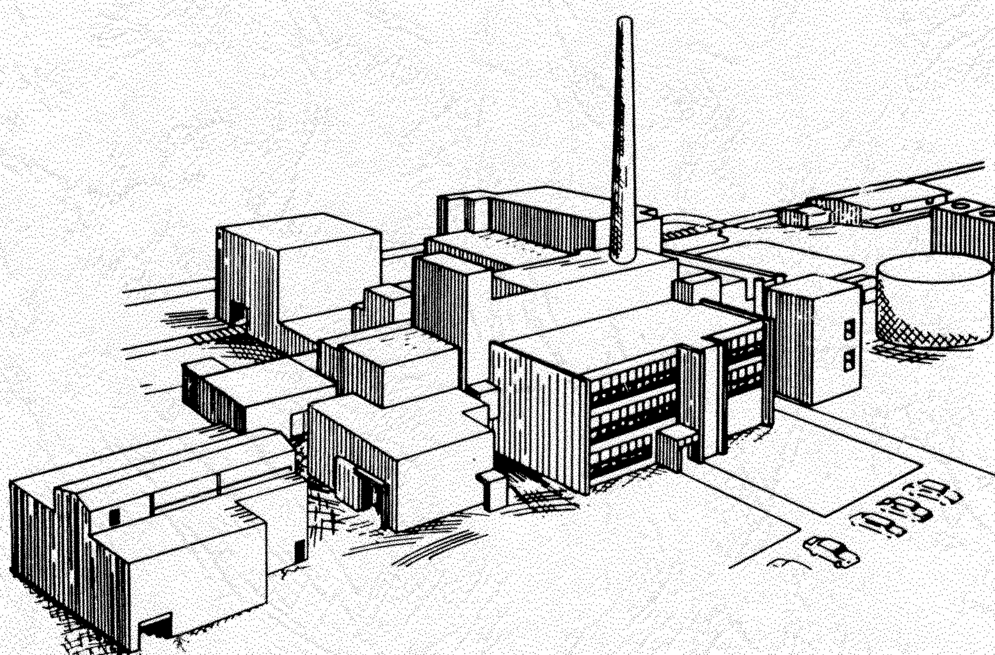
WEST VALLEY DEMONSTRATION PROJECT SITE ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1988



May 1989

West Valley Nuclear Services Company, Inc.
Rock Springs Road
West Valley, New York 14171-0191

PREPARED FOR:
U.S. Department of Energy
Idaho Operations
West Valley Project Office
Under Contract DE-AC07-81NE44139

Department of Energy
Idaho Operations Office
West Valley Project Office
P.O. Box 191
West Valley, NY 14171

Greetings:

Enclosed is the U.S. Department of Energy (DOE) West Valley Demonstration Project (WVDP) Annual Site Environmental Monitoring report for 1988. This report contains a summary of all radiological and nonradiological environmental monitoring data collected at the WVDP during the 1988 calendar year.

Collection of air, water, soil and food chain samples allows for the comprehensive detection and evaluation of any radioactive or hazardous material which may migrate off-site. During 1988, the Project did not exceed or even approach any regulatory limit on radioactivity or radiation dose. Nonradiological plant effluents, which are controlled and permitted by the New York State Department of Environmental Conservation (NYSDEC) and the Environmental Protection Agency (EPA), were also generally below regulatory limits. Exceptions occurred in some waste water discharges permitted under the New York State Pollutant Discharge Elimination System (SPDES) program. Several instances occurred when the SPDES permit standards were exceeded for iron concentration, pH, and biological oxygen demand. While these short duration excursions did not have a significant impact on the environment, control programs and equipment have either been installed or are being evaluated to eliminate future excursions of this type.

Recently the WVDP received a thorough environmental audit performed by a team of specialists representing DOE headquarters. This audit included a comprehensive review of all environmental monitoring programs. The team reviewed monitoring and data reporting of air, soil, surface water and groundwater parameters, as well as WVDP practices in waste management, hazardous and toxic materials management, quality assurance, and National Environmental Policy Act documentation. A total of 41 findings were identified in the August 1989 environmental compliance assessment report, of which 15 were related to federal, state, or DOE order requirements. No significant environmental compliance issues were identified. The remaining 26 findings were in the Best Management Practice category, which recommends improvements to procedures, the majority of which could be administratively or technically corrected with minor effort. The most significant team findings dealt with long-term waste management practices and were not directly related to environmental monitoring activities. Specific findings involved accelerating the scheduled upgrading of the existing monitoring network to conform to newly revised DOE Orders. The WVDP is working aggressively to complete monitoring program upgrades and expects to implement the majority of changes within the next year. Three exceptionally noteworthy practices were identified by the team and attributed to the environmental surveillance program.

The WVDP is preparing for negotiations with New York State and the Environmental Protection Agency to address radioactive mixed waste management activities within the context of a Federal Facilities Compliance Agreement. The WVDP has been proactively meeting with both regulatory entities to discuss technical issues and provide facility background. A signed agreement is anticipated for mid-1990.

This Report fulfills many DOE and regulatory reporting requirements and demonstrates that public health and safety are being protected with respect to the operation of the WVDP and the concerns associated with the waste materials being stored there. If you have any questions, please contact me at (716)942-4313.

Sincerely,

W. W. Bixby

W.W. Bixby, Director

West Valley Project Office

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PREFACE

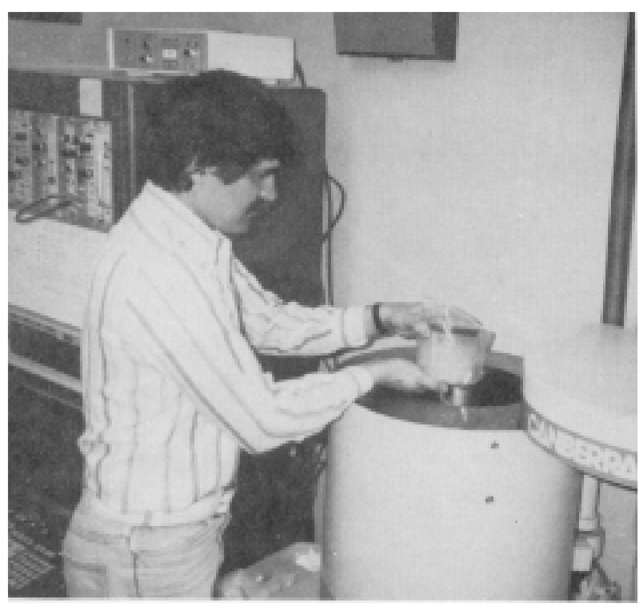
Environmental monitoring at the West Valley Demonstration Project (WVDP) is conducted by West Valley Nuclear Services Company, Inc. (WVNS), under contract to the U.S. Department of Energy. The data collected provide a historical record of radionuclide and radiation levels within the survey area attributable to natural and manmade sources. Data are also collected to monitor the quality of water discharged by the Project. In addition, wells adjacent to the site are routinely sampled.

This report represents a single, comprehensive source of off-site and on-site environmental monitoring data collected during 1988 by WVNS Environmental Monitoring Laboratory personnel. Appendix A is a summary of the sampling and analysis plan. Appendices C through E contain summaries of all data obtained during 1988 and are intended for individuals who are interested in more detail than is provided in the main body of the report.

Requests for additional copies of the 1988 Environmental Monitoring Report and questions concerning the report should be referred to the WVDP Community Relations Department, P.O. Box 191, Rock Springs Road, West Valley, New York 14171 [(716) 942-4610].

The West Valley Demonstration Project Site

Servicing a Perimeter Air Sampler



Counting a Water Sample in the Environmental Laboratory

EXECUTIVE SUMMARY

The West Valley Demonstration Project (WVDP) conducts a comprehensive environmental monitoring program to ensure public health and safety. Results from both on-site and off-site radiological and non-radiological measurements confirm that WVDP activities conducted in 1988 were well within Federal and State regulatory limits.

INTRODUCTION

This annual report presents a summary of environmental monitoring data collected at the WVDP during 1988. The report is published in accordance with the requirements of United States Department of Energy (DOE) Orders 5484.1 and 5400.1. In addition to DOE requirements, the site's environmental monitoring program fulfills regulatory requirements of the United States Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). In so doing, the program demonstrates that public health and safety are being protected with respect to activities on the site and the waste materials stored there.

In 1976, Nuclear Fuel Services, Inc. (NFS) notified the New York State Energy Research and Development Authority (NYSERDA) of its intention to terminate its lease on the nuclear fuel reprocessing facility at the Western New York Nuclear Service Center (WNYNSC). In 1980, the U.S. Congress directed the DOE (through Public Law 96-368) to carry out a high-level liquid nuclear waste management demonstration project at the WNYNSC facility. DOE assumed control of the portion of the Center which is now the WVDP site in early 1982. The objectives are to solidify 2.2 million litres (580,000 gallons) of liquid high-level radioactive waste (HLW) stored at the site, develop containers for the solidified HLW, transport the solidified HLW to a federal repository, dispose of Project low-level and transuranic waste, and decontaminate and decommission the Project facilities.

Through the mid-1980's West Valley Nuclear Services (WVNS), as prime contractor to DOE, constructed and secured environmental approval of various subsystems making possible the successful startup of the Integrated Radwaste Treatment System (IRTS) in May of 1988. In the first year of operation 523,000 liters (138,000 gals.) of liquid from the high-level waste tanks were processed through the IRTS.

Liquid discharges associated with project activities in 1988 totalled 21 million liters (8 million gals.). Total radioactivity released, through air and water, was reduced 20.5 percent from 1987 levels to 27 millicuries (gross alpha plus gross beta). During 1988, the environmental surveillance plan was expanded to provide continued monitoring of additional effluent points and areas of active waste management (see Appendix A).

The activities described above are being carried out at the WVDP site which is approximately 50 kilometers (30 miles) south of Buffalo, New York. The site is composed of a 63-hectare (156-acre) securely fenced area within a 1350-hectare (3300-acre) reservation (WNYNSC). Land immediately adjacent to the reservation is primarily used for farming. The site is located wholly within the Cattaraugus Creek drainage basin.

ENVIRONMENTAL MONITORING

The 1988 environmental monitoring program provided for radiological and non-radiological measurement of site effluent discharges and other on- and off-site samples. Collection of air and surface water samples allowed for monitoring of the two major pathways by which radioactive or hazardous material could migrate off-site. Analysis of animal, soil and vegetation samples from the facility environs provided data from which the risk of exposure through ingestion pathways could be determined. Control or background samples were taken to compare with on- or near-site samples. In 1988, the site recorded no abnormal radiological releases, and no special investigations of environmental radiological conditions were initiated.

During 1988, airborne particulate radioactivity was sampled continuously at five site perimeter and four remote locations. Sample filters were collected weekly and analyzed for gross alpha and beta radioactivity. Airborne gross activity around the site boundary was, in all cases, indistinguishable from background concentrations measured at the remote locations and well below DOE regulatory limits (see Appendix B). Direct monitoring of airborne effluents, at the main stack and other permitted release points, showed all discharges to be well below DOE or EPA effluent limitations.

Four automatic samplers collected surface water at locations along site drainage channels most likely to intercept off-site migration of radioactive material. Samples were analyzed for gross alpha, beta and gamma activity and for tritium and strontium-90. Average gross radioactivity concentrations continued to be higher in Buttermilk Creek below the WVDP site than at the upstream background sample point as a result both of historical and continuing treated liquid releases. However, average concentrations below the site in Cattaraugus Creek cannot be differentiated from background (upstream of the site). Concentrations of cesium-137, strontium-90, and tritium were all below DOE guidelines at all locations, including Frank's Creek at the inner security fence over three miles from Cattaraugus Creek. The largest single source of radioactivity released to surface water is from the Low-Level Waste Treatment Facility (LLWTF) through the Lagoon 3 weir. In 1988, five batch releases were made with average concentrations less than 40 percent of the release limit guidelines. Downstream sediment concentrations of cesium-137 have remained constant with time at any given sampling point.

Radioactivity in the food chain was measured by analyzing samples of milk, beef, hay, corn, tomatoes, apples, fish and venison collected during 1988. Strontium-90 determinations showed some variations from the previous year in background and near-site samples of fish and venison. No difference from background was noted for corn, apple and tomato samples collected near the site and analyzed for tritium and various gamma emitting isotopes. Near-site apple samples from within the WNYNSC showed strontium-90 detectable above background, but at levels far below any regulatory limits.

Direct environmental radiation was measured quarterly in 1988, as in previous years, using thermoluminescent dosimeters (TLDs). Monitoring is carried out at 40 points distributed around the site perimeter and access road, at the waste management units, at the inner facility fence and at various remote locations. No significant differences were noted among exposure rates measured at background and WNYNSC perimeter locations. Some TLD data were also collected within the restricted area boundary to monitor the higher-than-background exposure from nearby radioactive waste handling and storage facilities.

Regulation of non-radiological discharges from the site is a responsibility of NYSDEC. Because NYSDEC does not consider any on-site stationary sources of non-radiological airborne effluents to be of significant quantity, they do not require special monitoring and reporting. Liquid effluents are monitored as a requirement of the State Pollution Discharge Elimination System (SPDES), also administered by NYSDEC. Liquid discharges may occur at any of three permitted "outfalls," or points of final release to an unrestricted waterway. Project effluents were monitored for biochemical oxygen demand (BOD), suspended solids, ammonia, iron, pH, oil and grease, and other water quality factors. Monitoring indicated that liquid discharges had no significant effect on the environment.

GROUNDWATER MONITORING

The WVDP is underlain directly by layers of glacial sand, gravel and clay and/or by layers of deposited lake and stream materials. Underlying bedrock is primarily Devonian shales and sandstone. Non-uniformity of deposited material across the site results in uneven groundwater flow and seepage rates.

The 1988 groundwater monitoring program included on-site wells for waste management unit surveillance and off-site wells for drinking water monitoring. An on-site system of 14 wells, plus one groundwater seep and a french drain (an underground, gravel-filled drainage channel) provide upgradient and downgradient monitoring of the LLWTF lagoons, the high-level waste tank farm complex, and the NRC-licensed Disposal Area. All wells comprising the waste management unit groundwater monitoring program were sampled three times in 1988. A number of additional on-site wells provided semiannual data. After initial physical measurements at each well, samples were collected and analyzed for a variety of radiological and water quality parameters. The range of analyses performed was determined by regulatory requirements and specific concerns. Statistical tests were performed to define real differences between upgradient and downgradient wells.

The potential impact of project activities on near-site groundwater is monitored by biennial sampling of a group of designated private drinking water wells. Half of these wells are monitored each year primarily for the presence of radionuclides.

Data from groundwater monitoring around the LLWTF lagoons indicate that radionuclides from previous plant operation, most significantly tritium, have had an influence on groundwater quality. Historically, the level of tritium contamination in the groundwater around the lagoon system has steadily decreased, as indicated primarily by measurements at the french drain outfall. Gross beta measurements have confirmed that residual radioactivity (other than tritium) has remained essentially constant in this area. Other measured parameters, such as pH and conductivity, have shown significant difference between upgradient and downgradient locations. These differences do not reflect any degradation in water quality.

Data from around the waste tank farm do not indicate any impact of the stored high-level radioactive waste on the groundwater. Lack of significant differences between upgradient and downgradient samples around the NRC-licensed Disposal Area also indicate there is no discernible migration of groundwater contamination from this source. Data from other, older wells on site indicate localized tritium contamination north of the disposal area. Finally, monitoring of drinking water wells off site showed no detectable tritium, which is considered to be the most sensitive indicator of groundwater contamination from the WVDP.

RADIOLOGICAL DOSE ASSESSMENT

Potential doses to the public from airborne and liquid effluent releases of radioactivity from the site during 1988 were estimated using computer models. Potential radiation doses from ingestion of locally produced foods were also calculated and compared to results derived from the computer models.

An EPA-approved computer program (AIRDOS, CAAC version) was used to calculate radiation doses from airborne effluents. The highest dose to a nearby resident was estimated to be 0.00035 mrem, which is 0.0014 percent of the EPA limit. The maximum organ dose (to the thyroid) was estimated to be 0.0039 mrem, or 0.0051 percent of the EPA limit. These doses are 35 and 59 percent lower, respectively, than the previous year's estimates.

Computer modeling was also used to estimate a hypothetical maximum radiation dose from liquid effluents. The highest dose to an individual was estimated to be 0.1 mrem, which is 0.1 percent of the DOE limit. This dose is 60 percent lower than last year's estimate. Overall, the average dose from air and liquid discharges to individuals within an 80-km (50-mi) radius from the site was estimated to be 0.000018 mrem.

Radiation doses estimated from maximum consumption rates of locally produced foods were in the range of 0.0053 mrem (venison) to 0.18 mrem (milk). These doses are similar in magnitude to the values reported in previous years.

The above conservatively high, calculated doses can be compared to an actual dose of 300 mrem per year to the average person from natural background radiation. The dose assessment described in Section 4.0 predicts an insignificant impact on the public's health as a result of radiological releases from the WVDP.

STANDARDS AND QUALITY ASSURANCE

The WVDP is regulated by both Federal and State agencies seeking to protect the environment and provide for the safety of Project workers and the public. Laws and regulations that apply to the Project include: DOE Order 5480.1, "Requirements for Radiation Protection;" the Resource Conservation and Recovery Act (RCRA); Environmental Conservation Law of New York State; the National Emission Standards for Hazardous Air Pollutants (NESHAP); and many others.

The Quality Assurance (QA) Program overseeing environmental monitoring activities includes aspects which govern the production and analysis of data from both on- and off-site sources. Commercial contract laboratories and their own internal QA programs are routinely reviewed by site personnel. In addition, commercial laboratories must perform blind analyses of standard or duplicate samples submitted by the WVDP Environmental Laboratory.

On-site monitoring activities are subject to quality control checks from the time of sample collection through sample analysis and data reduction. Specific quality checks include: external review of sampling procedures, specific calibrations using primary standard materials; participation in formal laboratory cross check programs (for example, with EPA and DOE); outside auditing by organizations including the U.S. Nuclear Regulatory Commission (NRC) and Westinghouse Electric Corporation.

Environmental sample-sharing and co-location of measurement points with the New York State Department of Health (NYSDOH) and the NRC continued in 1988, assuring that selected samples and locations are routinely measured by two or more independent organizations.

Cross check program participation coupled with other internal quality control procedures and external laboratory checks verified the high overall quality of data gathered in 1988. Isolated problems involving inaccurate determinations by off-site contract laboratories and insensitivity of analytical methods used on site have been addressed and rectified.

COMPLIANCE

The West Valley Demonstration Project operates within the regulatory guidelines of the DOE Orders for protection of health, safety and the environment. Limits on radioactivity concentrations specified in the DOE Orders along with limits on the dose to the maximally exposed off-site individual from Project effluents act together to encourage high quality, low-activity air and water discharges. The Project did not exceed or even approach any regulatory limit on radioactivity or radiation dose in 1988.

Nonradiological plant effluents are controlled and permitted under NYSDEC and EPA regulations. Although there are periodic New York State inspections of air emission points, air effluent monitoring is not required because of the relatively innocuous nature of the discharges. Water quality, as measured by tests for pH, biochemical oxygen demand, and other chemical factors, is regulated by the NYSDEC. The SPDES permit identifies discharge quality limits which, if exceeded, require immediate corrective action. In 1988 there were 24 instances when individual water quality parameters exceeded permitted levels, out of a total of 372 measurements. The greater part of these excursions resulted from natural variations in the iron content of raw water entering the plant, or were related to the high concentrations of algae which thrived in the exceptionally warm weather of 1988. In each case, appropriate action was taken to stabilize the condition, and to notify the NYSDEC in accordance with permit conditions. These excursions resulted in no significant impact on the environment due to their innocuous nature, relatively short duration, and more than 10-fold dilution at Cattaraugus Creek, the first public access point that contains site discharges.

Finally, dose calculations for 1988 show that the WVDP is in compliance with the emission standards for radioactivity promulgated by the EPA. Non-radiological emissions of concern to the EPA are regulated directly by delegation to the State of New York.

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1.0 INTRODUCTION

This report presents the annual summary of environmental monitoring data collected at the West Valley Demonstration Project (WVDP) from January 1, 1988 through December 31, 1988. The report also describes the environmental monitoring program and discusses project compliance with state and federal regulations. Environmental monitoring is a continuing effort to help assure public safety with respect to the activities on the site and the waste materials which reside there.

1.1 HISTORICAL OVERVIEW

Starting in 1966 Nuclear Fuel Services (NFS) reprocessed fuel from various nuclear power plants at the Western New York Nuclear Service Center (WNYNSC) under a lease from the New York State Energy Research and Development Authority (NYSERDA). In 1972 the plant was closed for expansion. Increased federal and state regulations aimed at the planned expansion and facility operations made the required capital investment much more costly than had been anticipated. In 1976 NFS decided not to proceed with the plans and notified NYSERDA of its intent to terminate the lease, leaving the liquid radioactive waste in underground steel tanks, the approved method of storing high-level radioactive waste at the time.

The reprocessing plant was maintained and monitored in the shut down condition until Public Law No. 96-368 was enacted in 1980. The law mandated the demonstration of technology to solidify the 2.2 million litres (580,000 gallons) of liquid high-level radioactive waste that remained at the site. The Department of Energy (DOE) was given the responsibility to implement the law and chose West Valley Nuclear Services Company (WVNS), a subsidiary of Westinghouse Electric, for the operation and maintenance of the West Valley Demonstration Project.

The conversion of the plant facilities from reprocessing activities to waste handling and processing was designed to use existing facilities as much as possible. In addition to modification of the plant, WVNS assumed operational control of the environmental monitoring program conducted by NFS for the shutdown facility, as licensed by the Nuclear Regulatory Commission (NRC).

The site is also the location of an NRC-licensed low-level radioactive waste storage area and a state-licensed storage area. These areas are no longer active, but are carefully monitored and eventually will be closed with the remainder of the site when waste processing is completed.

The present environmental monitoring program was started in 1982. As new systems became operational and the activities changed from decontamination and decommissioning to system construction, the monitoring program has been changed to accommodate state and federal regulations and to include additional monitoring points. As recommended in DOE Order 5484.1, the program has provided more than two years of environmental data prior to high-level waste processing.

Activities of the program are documented under the National Environmental Policy Act (NEPA) which provides a formal way to plan and carry out significant work which might affect the environment. A comprehensive Environmental Evaluation (EE) was published in June 1984 to initiate the decision-making process for disposal of Project low-level radioactive waste (LLW). Based on the review of the EE by the DOE, the Project staff was directed to prepare an Environmental Assessment (EA) which analyzed alternative disposal options more thoroughly than was appropriate in the EE. In April of 1986, the DOE approved the LLW disposal EA, and after an appropriate public comment period, issued a Finding of No Significant Impact (FONSI) in August of the same year.

Environmental Evaluations were also prepared in 1985 and 1986 for the major solidification process support systems, including the Vitrification System, Supernatant Treatment System (STS), Cement Solidification System (CSS), and Liquid Waste Treatment System (LWTS). These documents were approved by WVNS management and submitted to DOE for review and approval.

1.2 1988 PROGRAM OVERVIEW

Significant activities during 1988 included startup of the Integrated Radwaste Treatment System (IRTS), increased attention to the management of mixed and hazardous wastes, and program changes to environmental documentation and the monitoring plan.

The IRTS processes high-level waste (HLW) fluids stored at the WVDP into low-level liquid that is stabilized in cement. This system is designed to remove approximately 90 percent of the total volume of liquid waste contained in an underground steel tank.

Approximately 35 million curies of radioactivity are present in this tank. Half of the radioactivity is contained in the supernatant or liquid portion of the waste and the other half is contained in the sludge located on the bottom of the tank. The supernatant is comprised primarily of sodium and potassium salts. Dissolved radioactive cesium makes up greater than 99 percent of the total activity of fission products in the supernatant. Most of the radioactivity in the sludge is due to the decay of strontium. The largest chemical constituent in the sludge is iron hydroxide.

The IRTS is made up of four subsystems, the Supernatant Treatment System , the Cement Solidification System, the Liquid Waste Treatment System, and the Drum Cell. The STS uses the containment of a second steel storage tank identical to the one which holds the HLW. Four ion exchange columns are filled with zeolite to remove more than 99.9 percent of the radioactive cesium from the supernatant. The cesium-loaded zeolite from the STS process, together with some additional waste left from reprocessing will eventually be combined with the sludge in the bottom of the tank and transferred to the Vitrification Facility (VF). Pumps will be used to dislodge and move both sludge and zeolite. The first zeolite pump was installed, checked out and started up in 1988. In the VF the high-level sludge, additional waste, and zeolite resins will be mixed with glass formers and melted to produce borosilicate glass, the final solidified HLW form, which will then be encapsulated in stainless steel canisters.

The remaining three IRTS subsystems, LWTS, CSS, and the Drum Cell, collect, segregate, characterize, pretreat, reduce and solidify in cement all liquid LLW remaining after the STS process. The liquid salt solution from the STS is concentrated by evaporation in the LWTS, encapsulated into cement at the CSS and stored in the Drum Cell. Located southwest of the main plant near the NRC-licensed disposal area, the Drum Cell is a large shielded structure enclosed in a building designed to store 15,000 268-litre (71-gallon) drums of processed LLW. After the Drum Cell is filled, the stored LLW may be removed for disposal or the building may be dismantled and the shielded structure converted into an above-ground tumulus for final disposal. A decision on final disposal of Project LLW will be made after completion of the Environmental Impact Statement (EIS) for the postsolidification phase (Phase II) of the WVDP. A Notice of Intent (NOI) to prepare an EIS was published in December 1988 and a public hearing was held to receive comments in February 1989.

The Drum Cell was completed in 1987 to store Class B and C low-level radioactive wastes (as defined by 10 CFR 61). Covered storage facilities for Class A wastes were also expanded in 1987. The expansion of LLW storage facilities was necessary to fulfill the conditions of a settlement agreement resulting from a lawsuit brought against the Project by the Coalition on West Valley Nuclear Wastes and the Radioactive Waste Campaign. This settlement requires that LLW not be disposed on the Project premises until the EIS is prepared. The NOI to prepare the EIS was published at the end of 1988 to begin the process. Both operational and environmental monitoring programs have been expanded to accommodate these expanded storage operations.

A significant milestone for the WVDP was achieved with start-up of the IRTS on May 23, 1988. After an extensive, independent week-long review of the IRTS, an Operational Readiness Review Board (ORRB) recommended operation of the system. During the review, all operational and environmental safety aspects of the IRTS were thoroughly scrutinized by representatives of the DOE, NYSERDA, WVNS, and the Westinghouse Electric Corporation. Representatives from the NRC also attended the review and agreed that the IRTS was capable of operating in an efficient and environmentally safe manner. Formal start-up approval from the DOE Idaho Operations Manager was obtained on May 20, 1988.

During the course of the first year of operations 138,000 gallons of waste were processed and 2607 cement drums were filled and stored in the Drum Cell.

Throughout 1988 liquid wastes resulting from plant activities were processed at the existing Low-Level Waste Treatment Facility (LLWTF) prior to discharge. During 1988 the volume discharged from the Project to the environment was 21 million liters (8 million gals.); this was 16 percent below 1987 or a reduction of 5.7 million liters (1.5 million gals.). The total amount of radioactivity released was reduced by 20.5 percent from 34 mCi (gross alpha plus beta) in 1987 to 27 mCi in 1988.

During routine weekly environmental sampling in the former low-level radioactive waste disposal area in mid-August, approximately one cup of slightly radioactive kerosene was discovered in a previously installed groundwater monitoring well. Analysis indicated the kerosene contained residual amounts of fission products and trace amounts of plutonium. Further investigation showed that the solvent had migrated approximately 2 meters (6 feet) from the area where it was disposed by the former site operator. The appropriate local, state, and federal agencies were notified. The monitoring stations for surface water and air in the surrounding vicinity showed no increase in radioactivity, confirming no releases of either solvent or radioactivity off site. A more detailed program is planned to characterize and confirm the localized nature of the migration.

The on-site storage pool contains 125 spent fuel assemblies awaiting shipment to the DOE Idaho National Engineering Laboratory (INEL) as part of a demonstration under the Nuclear Waste Policy Act (NWPA). Shipment is waiting on cask certification by the NRC. The current schedule is to ship half of the elements in FY 1989 and half in FY 1990.

Since environmental safety and health is of the utmost concern at the WVDP, several measures were taken in 1988 to assure continued compliance with federal and state regulations. Among the accomplishments in the area were revision of procedures to comply with the NEPA and a major revision of the Spill Prevention, Control and Countermeasures (SPCC) Plan, which gives procedures for responding to emergencies caused by spills of hazardous liquids. Discussions began with the New York State Department of Environmental Conservation (NYSDEC) and the U. S. Environmental Protection Agency (EPA) on requirements for handling mixed waste.

During 1988 the environmental surveillance plan was again updated to reflect the nearing completion of process facilities. The revisions also reflected Project monitoring experiences to date. The updated plan provides for coverage of new on-site effluent points and monitoring of active waste management areas. The revised plan is described in detail in Appendix A.

1.3 SITE CHARACTERISTICS

The WVDP site is located in a rural setting approximately 50 km (30 mi) south of Buffalo, New York (Figure 1-1), at an average elevation of 400 m (1,300 ft) on New York State's western plateau. The plant facilities used by the Project occupy approximately 63 hectares (156 acres) of chain-link fenced area within a 1,350-hectare (3,300-acre) reservation that constitutes the Western New York Nuclear Service Center (WNYNSC). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 km (5 mi) of the plant. Several roads and one railway pass through the Center, but no human habitation, hunting, fishing, or public access is permitted on the WNYNSC.

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek to the north serves as a water recreation area (swimming, canoeing, and fishing). Although limited irrigation water for adjacent golf course greens and tree farms is taken from Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC.

The average annual temperature in the region is 7.2 °C (45.0 °F) with recorded extremes of 37 °C

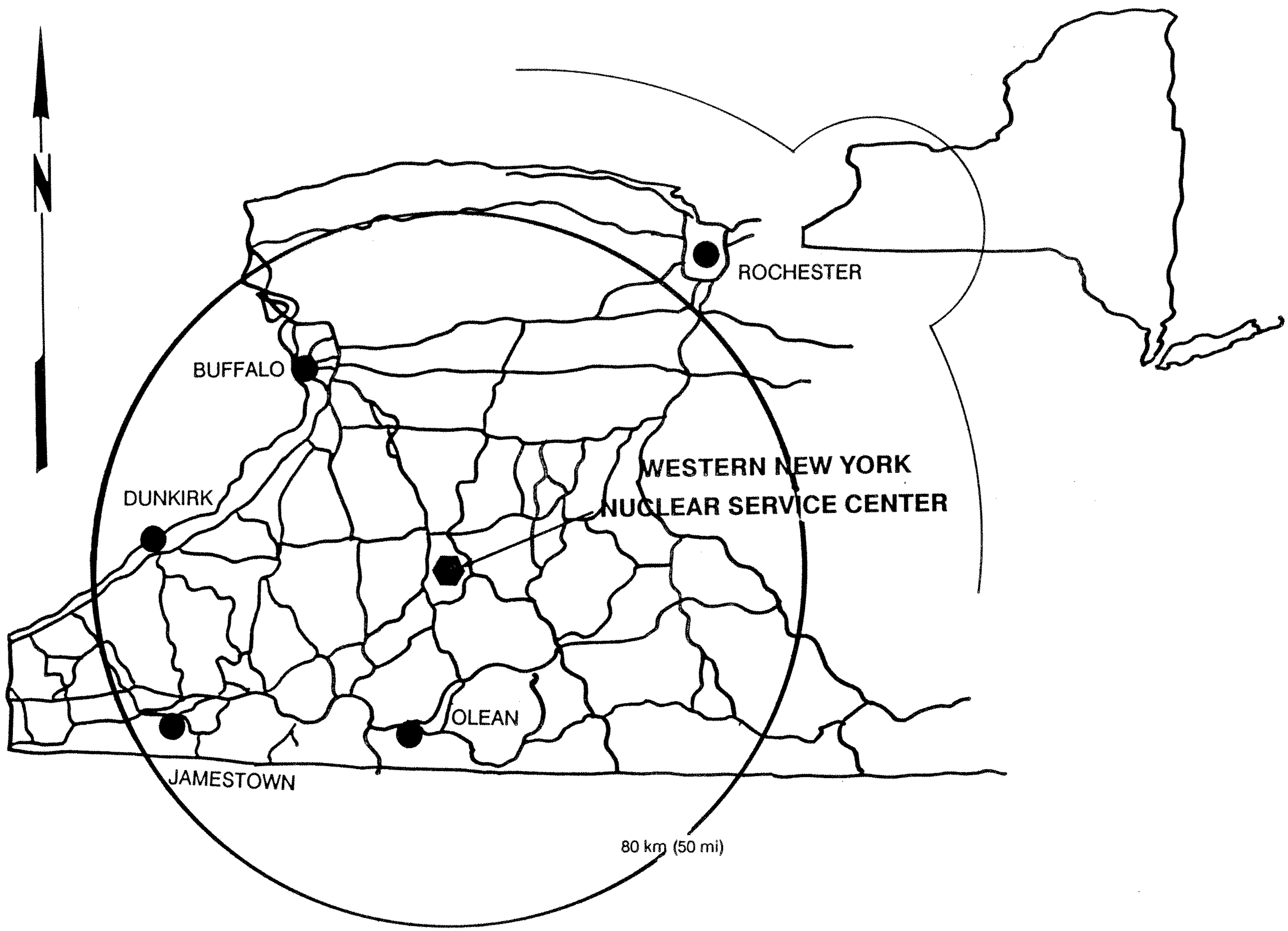


Figure 1-1. Location of the Western New York Nuclear Service Center.

(98.6 °F) and -42 °C (-43.6 °F). Rainfall is relatively high, averaging about 104 cm (41 in.) per year. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and Lake Ontario to the north. All surface drainage from the WNYNSC is to Buttermilk Creek which flows into Cattaraugus Creek and ultimately into Lake Erie. Regional winds are predominantly from the west and south at over 4 m/s (9 mph) during most of the year.

The WNYNSC lies within the northeastern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land, the site provides habitats especially attractive to white-tailed deer and the various indigenous birds, reptiles, and small mammals. No endangered species are known to be present on the WNYNSC.

The geology of the site is characterized by glacial deposits of varying thickness in the valley areas underlain by sedimentary rocks which are exposed in the upper drainage channels in hillsides. The soil is principally silty till consisting of unconsolidated rock fragments, pebbles, sand, and clays. The uppermost till unit is the Lavery, a very compact gray silty clay. Below the Lavery till is a more granular unit referred to as the Lacustrine unit comprised of silts, sands, and in some places, gravels which overlie a layered clay.

There are two aquifers in the site area. The upper aquifer is a transient water table aquifer in the upper 6 m (20 ft) of weathered till and alluvial gravels concentrated near the western edge of the site. High ground to the west and the Buttermilk Creek drainage to the east intersect this aquifer, precluding off-site continuity. Several shallow, isolated, water-bearing strata also occur at various other locations within the site boundary but do not appear to be continuous. The zone at which the till meets bedrock forms another aquifer that ranges in depth from 2 m (6 ft) underground on the hillsides to 170 m (560 ft) deep just east of the boundary of the facility exclusion area.

A more detailed description of the site hydrogeology is included in Section 3.1.

1.4 ARRANGEMENT OF REPORT

The report is arranged in five sections followed by references and appendices. After the introduction, Section 2 includes a description of the environmental monitoring plan and summarizes results from the 1988 program. Section 3 provides information about the groundwater monitoring program and results. Section 4 explains the methods of estimating doses to the public from air and water effluents and biological pathways. Section 5 provides a listing of DOE Orders and regulations affecting the Project and explains the quality assurance provisions of the monitoring program. Section 6 contains the references for the report. The appendices begin with a full schedule of environmental monitoring for on-site, off-site and effluent monitoring. Appendix B is a listing of DOE derived concentration guides for the nuclides of concern in this report. Appendices C-1 through C-5 provide the summarized data from this year's monitoring in table format. Appendix D is a listing of cross-check sample results to support the quality assurance section. Appendix E provides supporting tables and figures for the groundwater monitoring section. The report ends with a glossary, listing of acronyms, and unit abbreviation and conversion tables for items and values used in the report.

2.0 ENVIRONMENTAL MONITORING PROGRAM - DESCRIPTION AND RESULTS

The environmental monitoring program for the WVDP has been developed to detect any changes in the environment resulting from the Project activities. The monitoring network and sample collection schedule have been designed to accomodate specific biological and physical characteristics of the area surrounding the site.

The current monitoring program is a continuation of the environmental surveillance conducted by the WVNS since March of 1982. As new systems started up, additional monitoring points were selected and sampled. The present program, revised in 1987 for use in 1988, has three foci: effluent monitoring, on-site monitoring and off-site monitoring. Within these three areas samples are measured for radiological and non-radiological parameters. The monitoring schedule is included in Appendix A. Samples are designated by a coded abbreviation which includes sample type and location. A complete listing of the designations is provided in an index to the monitoring schedule.

The major pathways for movement of hazardous materials or radionuclides away from the site are by surface water drainage and airborne transport. For that reason, the environmental monitoring program emphasizes the collection of air and surface water samples. Another potentially significant pathway is the ingestion and assimilation of radionuclides by game animals and fish that include the WNYNSC in their range. Appropriate animal, soil and vegetation samples are gathered and analyzed for radionuclide content in order to reveal any long-term trends. To complete the picture, samples of meat, milk and produce are taken from nearby farms and analyzed. In addition, background sample points for all media have been selected well away from any possible influence of the plant. These samples provide control values for comparison with monitoring results.

The WVDP participates in the State Pollution Discharge Elimination System (SPDES) and operates under state-issued air discharge permits for non-radiological plant effluents. Radiological air discharges also must comply with the National Emission Standards for Hazardous Air Pollutants (NESHAP). The data gathering, analysis, and reporting to meet the requirements of all permits are an integral part of the WVDP monitoring program.

2.1 Radiological Monitoring

Air, water, and selected biological media were sampled and analyzed to meet DOE and plant Operational Safety Requirement (OSR) monitoring requirements. There were no abnormal radiological releases or special investigations of environmental radiological conditions in 1988.

2.1.1 Radioactivity in Air

In 1988 airborne particulate radioactivity was collected continuously at five locations around the perimeter of the site and at four remote locations at Great Valley, West Valley, Springville, and Dunkirk, as shown in Figure 2-1. Perimeter locations are on Fox Valley Road, Rock Springs Road, Route 240, Thomas Corners Road and Dutch Hill Road. These locations were chosen to provide data on the highest likely perimeter concentrations based on meteorological observations in the area. The remote locations were chosen to provide data from nearby communities and from natural background areas.

The air samples are collected by drawing air through a very fine filter with a vacuum pump. The total volume of air drawn through the sampler is measured and recorded by a meter. The filters trap any particles of dust which are then tested in the laboratory for radioactivity. Three of the perimeter air samplers, mounted on 4-m (13 ft.) high towers, maintain an average air flow of about 40 L/min (1.5 ft3/min) through a 47-mm glass fiber filter. The remaining perimeter samplers and the four remote samplers operate with the same air

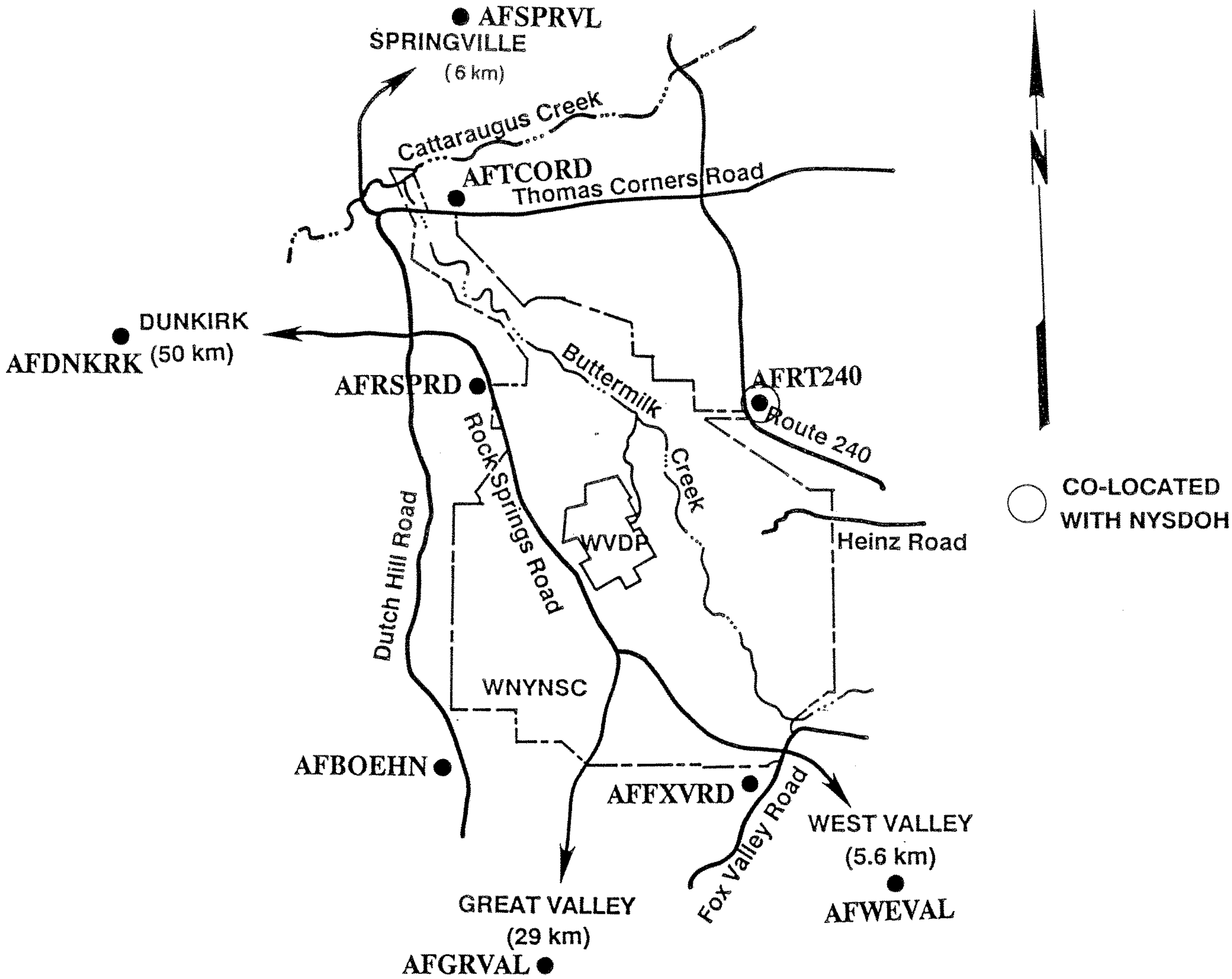


Figure 2-1. Off-site Air Sampler Locations.

flow rate as the three mounted on towers, but the sampler head is set at 1.7 m (5.6 ft.)above the ground (the height of the average human breathing zone).

Concentrations measured at Great Valley (AFGRVAL, 29 km south of the site) and Dunkirk (AFDNKRK, 50 km west of the site) are considered to be representative of natural background. Data from these samplers are provided in Appendix C-2, Tables C-2.2.7 and C-2.2.8.

Filters from all samplers were collected weekly and analyzed after a seven-day decay period to remove interference from short-lived naturally occurring radioactivity. Gross alpha and gross beta measurements of each filter were made using a low-background gas proportional counter. A complete tabulation of the concentrations measured at each of these stations is given in Tables C-2.2.1 through C-2.2.9.

The average monthly concentrations ranged from 8.9 E-15 to 4.2 E-14 μCi/mL (3.3 E-4 to 1.6 E-3 Bq/m3) of beta activity and 5.4 E-16 to 2.5 E-15 μCi/mL (2.0 E-5 to 9.3 E-5 Bq/m3) of alpha activity. In addition, quarterly composites consisting of 13 weekly filters from each sample station were analyzed for Sr-90 and gamma-emitting nuclides.

In all cases, the measured monthly gross activities were well below 3 E-12 μCi/mL (1.1 E-1 Bq/m3) beta, and 2 E-14 μCi/mL (7.4 E-4 Bq/m3) alpha, the most limiting DOE Derived Concentration Guides (DCGs) for any of the isotopes present at the WVDP. (DOE standards and DCGs for radionuclides of interest at West Valley are provided in Appendix B.)

Annual data for the three samplers which have been in operation since 1983 average about 2.2 E-14 μCi/mL (8.1 E-4 Bq/m3) of gross beta activity in air. The annual average gross beta concentration at the Great Valley background station was 2.1 E-14 μCi/mL (7.8 E-4 Bq/m3) in 1987, and averaged 2.1 E-14 μCi/mL (7.8 E-4 Bq/m3) again in 1988.

Global fallout is also sampled at four of the perimeter air sampler locations. Material from open pots located near the samplers is collected and analyzed every month. The 1988 data from these analyses are presented in Appendix C-2, Tables C-2.3.1 and C-2.3.2. These collections represent an indication of short-term effects. Long-term deposition is measured by surface soil samples collected every three years near each air sampling station.

The exhaust air from each ventilation system serving the site facilities is continuously filtered, monitored, and sampled as it is released to the atmosphere. Specially designed "isokinetic" nozzles continuously remove a representative portion of the exhaust air which then is drawn through very fine, small, glass-fiber filters to trap any particles. Sensitive detectors continuously measure the radioactivity on these filters. The detection instruments provide remote readouts of alpha and beta radioactivity levels to control display panels. A separate stack monitoring sample unit on each system provides another air filter that is removed every week and subjected to additional laboratory testing.

Because these concentrations are quite low, the large weekly volume samples from the plant stack provide the only practical means of determining the amount of specific radionuclides released from the facility.

The main ventilation stack (ANSTACK) sampling system remained the most significant airborne effluent point in 1988. A high sample collection flow rate through multiple intake nozzles assures a representative sample for both the weekly filter and the online monitoring system. Variations in monthly concentrations of airborne radioactivity reflect the level of Project activities within the facility (Table C-2.1.1). However, at the point of discharge, average radioactivity levels were already below the concentration guides for airborne radioactivity in an unrestricted environment (see Table C-2.1.3). Further dilution from the stack to the site boundary reduces the concentration by an average factor of about 236,000.

The total quantity of gross alpha and beta radioactivity released each month from the main stack, based on the weekly filter measurements, is shown in Table C-2.1.1 of Appendix C-2. The results of analyses for specific radionuclides in the four quarterly composites of stack effluent samples are listed in Table C-2.1.2.

Sampling systems similar to the main stack system monitor airborne effluents from the Cement Solidification System ventilation stack (ANCSSTK), the Contact Size Reduction Facility ventilation stack (ANCSRFK), and the Supernatant Treatment System ventilation stack (ANSTSTK). The 1988 samples showed detectable gross radioactivity, including specific beta- and alpha-emitting isotopes, but did not approach any DOE effluent limitations (Tables C-2.1.4 through C-2.1.9).

Three other facilities are routinely monitored for airborne radioactivity releases: the Low-Level Waste Treatment Facility (LLWTF), the contaminated clothing laundry, and the Supercompaction Volume Reduction System (ANSUPCV). Results are presented in Tables C-2.1.10 and C-2.1.11.

The total amount of radioactivity discharged from facilities other than the main ventilation stack was less than 2 percent of the airborne radioactivity released from the site, and was not a significant factor in the airborne pathway in 1988.

2.1.2 Radioactivity in Surface Water and Sediment

Four automatic samplers collect surface water at points along the site drainage channels. Points for water collection were chosen at locations most likely to show any radioactivity released from the site. A background station was chosen upstream of the site. These samplers operate by drawing water through a tube extending to an intake below the stream surface. A battery-powered pump is electronically controlled to first blow air through the sample line to clear any debris. The pump then reverses to draw a measured sample from the stream into a large container. Finally the pump again reverses to blow air back into the tube to clear the sample line. The pump and container are housed in a small, insulated and heated shed to allow sampling throughout the year.

An off-site sampler is located on Cattaraugus Creek at Felton Bridge just downstream of the confluence with Buttermilk Creek, the major surface drainage from the WNYNSC (Figure 2-2). This sampler (WFFELBR) periodically collects an aliquot (a small volume of water, approximately 100 mL/hr) from the creek. A chart recorder keeps track of the stream depth over the sample period and provides a means of proportioning a flow-weighted weekly sample into a monthly composite based on relative stream depth. Gross alpha, beta, and tritium analyses are performed each week, and the composite is analyzed for strontium-90 and gamma-emitting isotopes.

In addition to the Cattaraugus Creek sampler, two surface water monitoring stations are located on Buttermilk Creek. Samplers collect water from a background location upstream of the Project (WFBCBKG) and from a location at Thomas Corners Road downstream of the plant and upstream of the confluence with Cattaraugus Creek (WFBCTCB). These samplers operate in a time composite mode, collecting a 25-mL aliquot every half-hour. Samples are collected biweekly, composited monthly, and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite of the biweekly samples is analyzed for gamma-emitting isotopes and strontium-90.

The fourth station (WNSP006) is located on Frank's Creek where Project site drainage leaves the security area (Figure 2-3). This sampler operates in a time-composite mode, collecting a 50-mL aliquot every half hour. The sample is collected weekly, analyzed for tritium, gross alpha and gross beta radioactivity and composited quarterly. The quarterly composite is analyzed for strontium-90, iodine-129, alpha-emitting isotopes and gamma-emitting isotopes.

Tabulated data from surface water samplers are provided in Appendix C-1, Tables C-1.2 through C-1.5 .

Radiological concentration data from these sample points show that average gross radioactivity concentrations generally tend to be higher in Buttermilk Creek below the WVDP site, presumably because of the small amount of activity from the site which enters via Frank's Creek. The range of gross beta activity, for example, was 2.2 E-9 to 5.4 E-9 μCi/mL (8.1 E-2 to 1.0 E-1 Bq/L) upstream in Buttermilk Creek at Fox Valley (WFBCBKG), and

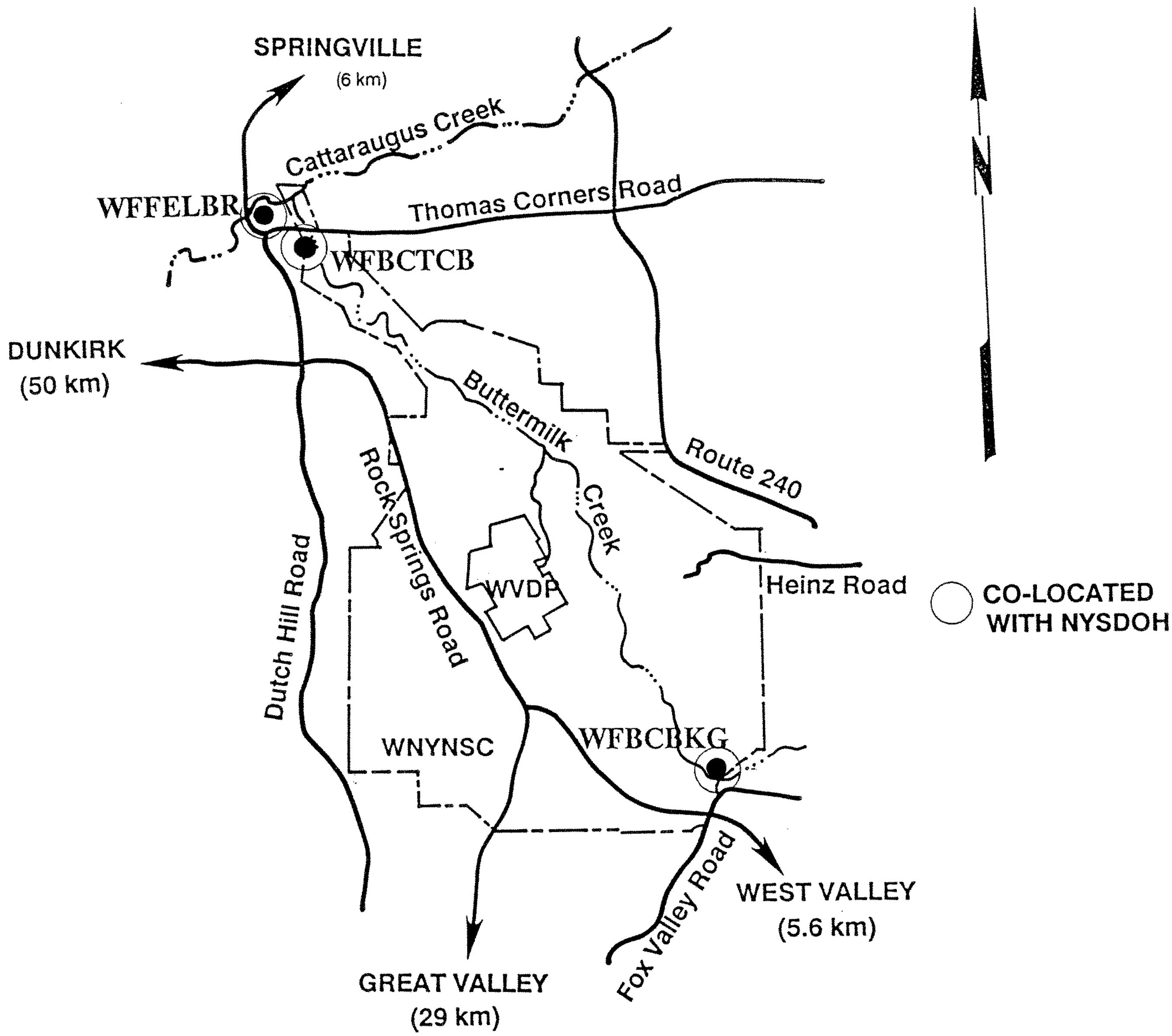


Figure 2-2. Sampling Locations for Off-Site Surface Water.

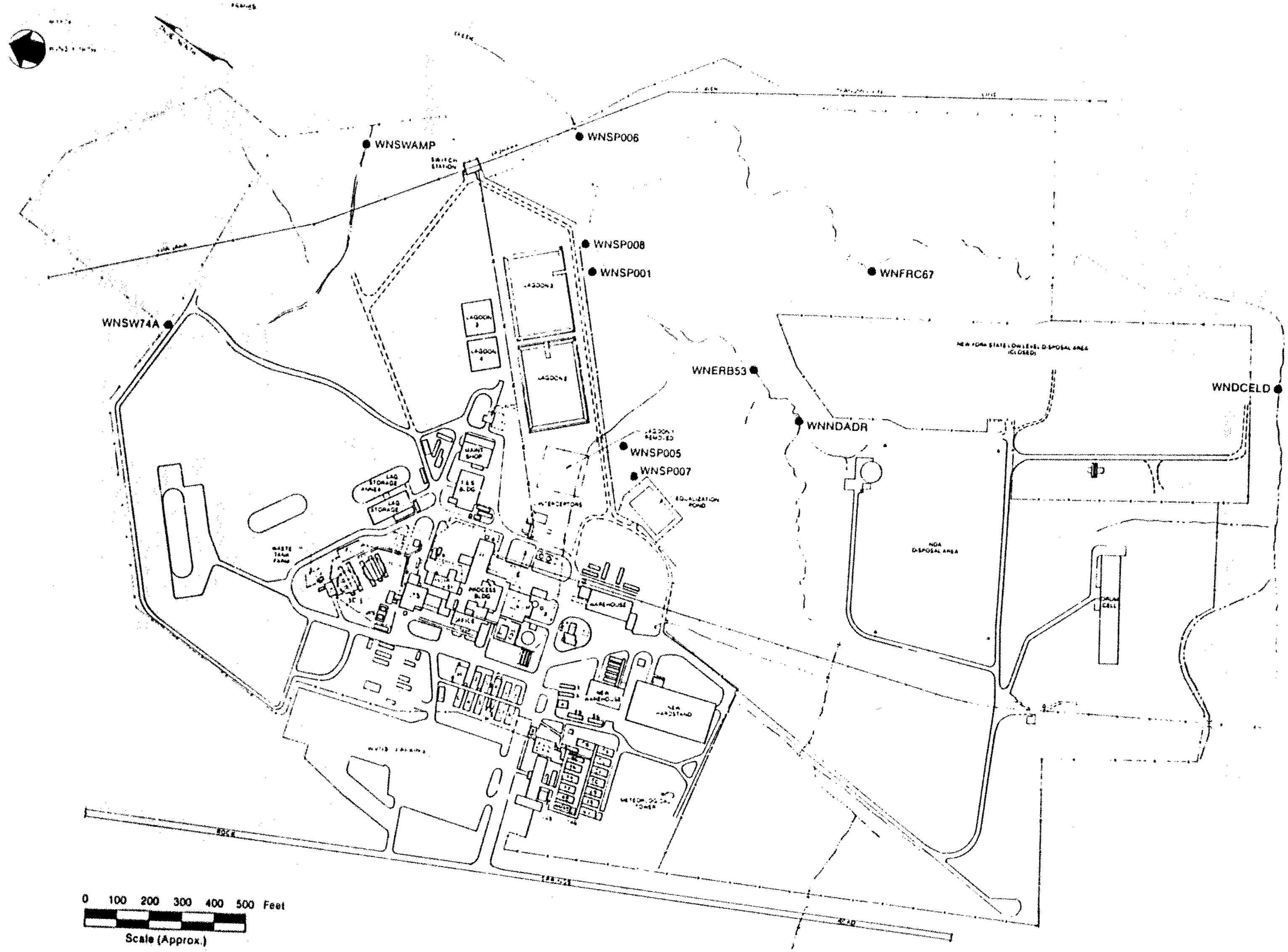


Figure 2-3. Sampling Locations for On-Site Surface Water.

from 3.8 E-9 to 8.2 E-9 μCi/mL (1.4 E-1 to 3.0 E-1 Bq/L) in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB). (See Tables C-1.2 and C-1.3). However, the average concentrations below the site in Cattaraugus Creek are not significantly higher than the Buttermilk Creek background (upstream) concentrations.

In comparison, if the most restrictive beta-emitting radionuclide is used (iodine-129), the maximum concentration measured in Buttermilk Creek at Thomas Corners Bridge where dairy cattle have access is 1.6 percent of the DOE derived concentration guide (DCG) for unrestricted use (Appendix B). At the Project security fence over 4 km from the nearest public access point, the most significant beta-emitting radionuclides were measured at 1.6 E-7 μCi/mL (5.9 Bq/L) for cesium-137 and 2.2 E-8 μCi/mL (8.1 E-1 Bq/L) for strontium-90 during the period of highest concentration. This corresponds to 5.3 and 2.2 percent of the DCGs for cesium-137 and strontium-90, respectively. The annual average was 2.7 percent for cesium and 1.7 percent for strontium. Tritium, at an annual average of 6.6 E-7 μCi/mL (2.4 E1 Bq/L), was 0.03 percent of the DCG values. Except for two months of the year, the gross alpha was below the average detection limits of 1.5 E-9 μCi/mL (5.6 E-2 Bq/L), or less than 5 percent of the DCG for americium-241. The positive values were 20 and 9 percent of the DCGs in June and October, respectively, assuming that all alpha-emitting isotopes were americium-241.

The highest concentrations in monthly composite water samples from Cattaraugus Creek during 1988 show strontium-90 to be less than 0.9 percent of the DCG for drinking water. No gamma-emitting fuel cycle isotopes were detected in Cattaraugus Creek water during 1988 (Table C-1.5).

The largest single source of radioactivity released to surface waters from the Project is the discharge from the LLWTF through the Lagoon 3 weir (WNSP001, Figure 2-3) into Erdman Brook, a tributary of Frank's Creek. There were five batch releases totalling about 30 million liters in 1988. The effluent was grab sampled daily during the 31 days of release and analyzed. The total amounts of activity in the effluent are listed in Table C-1.1.1. Of the activity released, 6.4 percent of the tritium and 2.6 percent of the other gross radioactivity originated in the New York State disposal area (based on measurements of water transferred in 1988 from the state area to the LLWTF) and not from previous or current Project operations (see Table C-1.8). The annual average concentrations from the Lagoon 3 effluent discharge weir, including all measured isotope fractions, was less than 40 percent of the DCGs (Table C-1.1.2).

Available results for sediment sampling from streams above and below the Project are shown in Table C-1.7. These results are similar to those obtained for gamma-emitting nuclides during 1987. A comparison of 1986-1988 cesium-137 data for the two upstream locations and the three downstream locations is presented in Figure 2-4. As indicated, cesium-137 concentrations are decreasing or staying constant with time for the locations downstream of the project (SFTCSED,SFCCSED, and SFSDSED). Concentrations of cesium-137 in upstream locations have remained consistant through the time period. A comparison of cesium-137 to naturally occurring potassium-40 is shown in Figure 2-5 for the

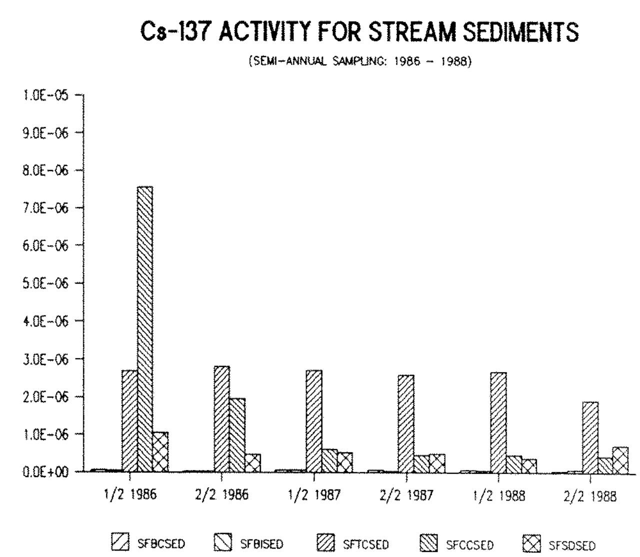


Figure 2-4. Cesium-137 concentrations (μCi/g dry) in stream sediment at two locations upstream and three locations downstream of the WVDP.

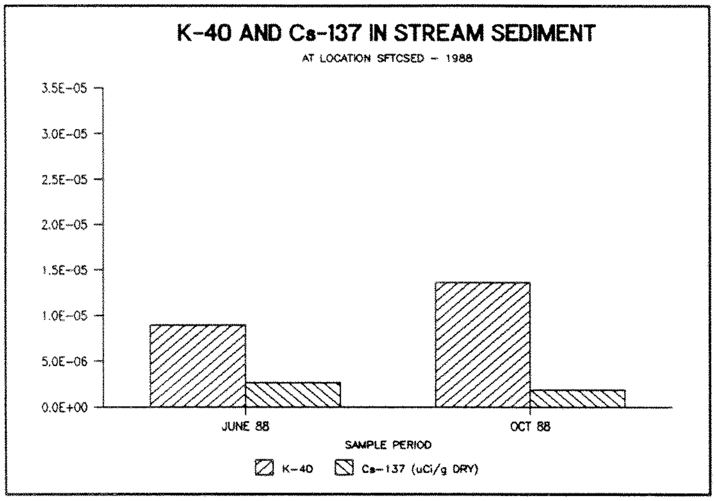


Figure 2-5
Comparison of naturally occuring potassium-40 and cesium-137 at downstream sampling location SFTCSED.

downstream location nearest the Project (SFTCSED) and indicates that cesium-137 is present at levels lower than naturally occurring gamma emitters.

2.1.3 Radioactivity in the Food Chain

Samples of fish and deer were collected near the site and from remote locations during periods when they would normally be taken by sportsmen for consumption. Milk and beef from cows grazing near the site and at remote locations as well as hay, corn, tomatoes, and apples were also collected and analyzed during 1988. Locations of remote background samples are shown on Figure 2-6. The results of these analyses are presented in Appendix C-3.

Fish samples were taken semiannually during 1988 above the Springville dam from the portion of Cattaraugus Creek which receives WNYNSC drainage (BFFCATC). Ten fish were collected from this section of the stream during each period. The strontium-90 content and gamma emitting isotopes in flesh were determined for each specimen. An equal number of fish samples (BFFCATD) were taken from Cattaraugus Creek below the dam, including species which migrate nearly 64 km (40) miles upstream from Lake Erie. These specimens were representative of sport fishing catches in the drainage downstream of the dam at Springville.

Control samples provide comparisons with the concentrations found in fish taken from site-influenced waters. A similar number of fish were taken from waters that are not influenced by site runoff (BFFCTRL), and their edible portions were analyzed for the same isotopes. These control (natural background) samples were representative of the species collected in Cattaraugus Creek downstream from the WVDP (Table C-3.4).

The concentrations of strontium-90 in the edible flesh of fish sampled above the Springville dam and at the background location during the 3rd quarter of 1988 show an increase from the levels detected in 1987 samples to the levels noted in 1986. The strontium-90 concentrations in edible flesh of fish sampled below the dam during this period remain at the lower 1987 levels. The log-normal statistical treatment of the fish data presented in Table C-3.4 is appropriate to the sample type being reported [Corley et al. 1981].

Portions of venison were analyzed from three deer taken from a resident herd on the southeast side of the WNYNSC. The average concentration of strontium-90 in venison was slightly higher than the concentration in the previous year's sample, while the average concentration of cesium-137 decreased slightly. Data from control, or background, deer samples collected in November 1988 near Olean 65 km (40 miles) southeast of the site indicated a slight increase in radioactivity from 1987 levels. Both sets of 1988 data are shown in Table C-3.2 for comparison.

With the exception of strontium-90 in the November 1988 local beef sample, the concentration of radioactivity in meat from semiannual samples of local beef animals was indistinguishable from the concentration in control samples (Table C-3.2).

Milk samples were taken in 1988 from dairy farms near the site (Figure 2-7) and from control farms at some distance. Besides the quarterly composite sample from the maximally exposed herd to the north (BFMREED), an additional quarterly composite of milk was taken from a nearby herd to the northwest (BFMCOBO). Single samples were

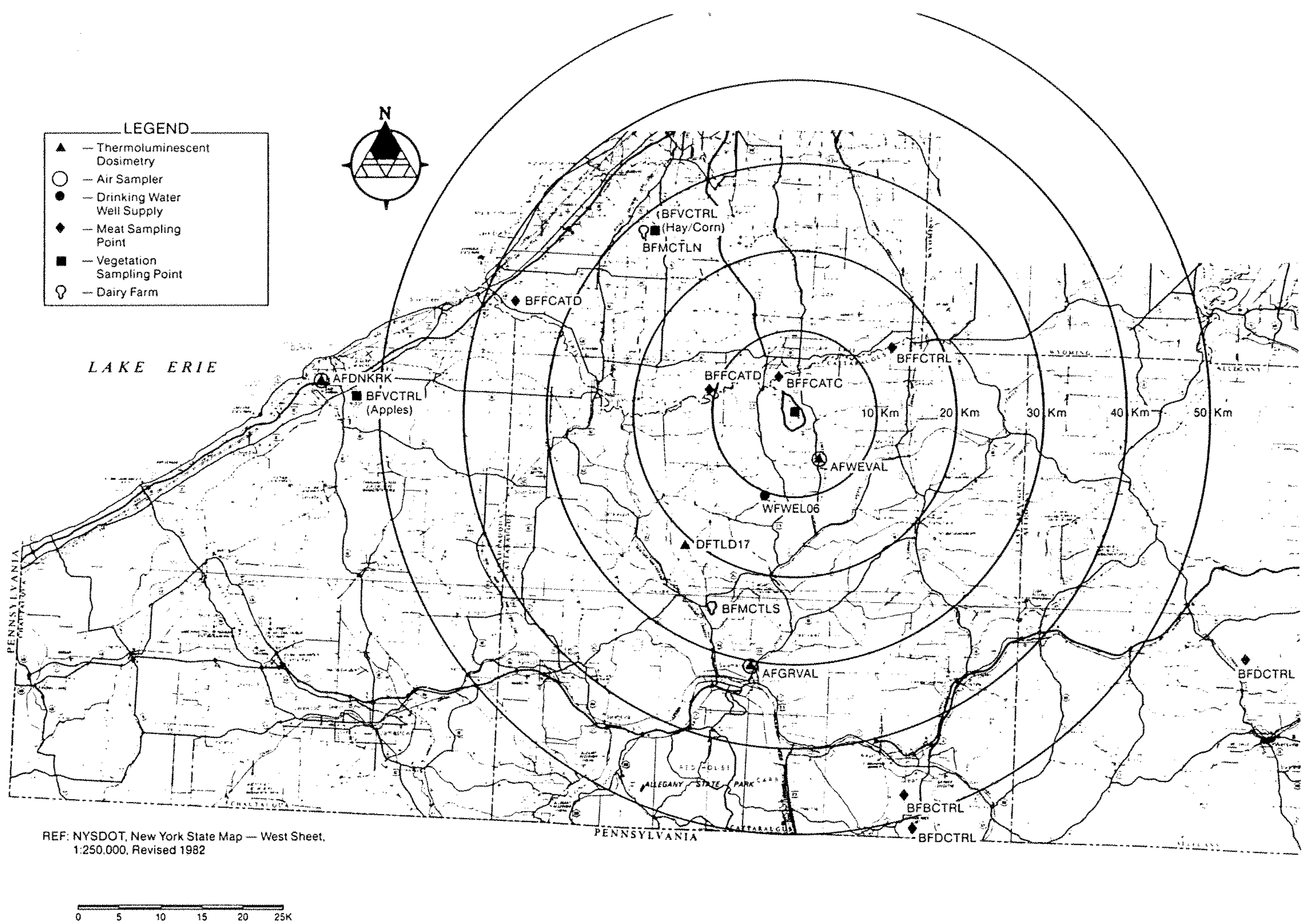


Figure 2-6. Sample Points in WVDP Environs.

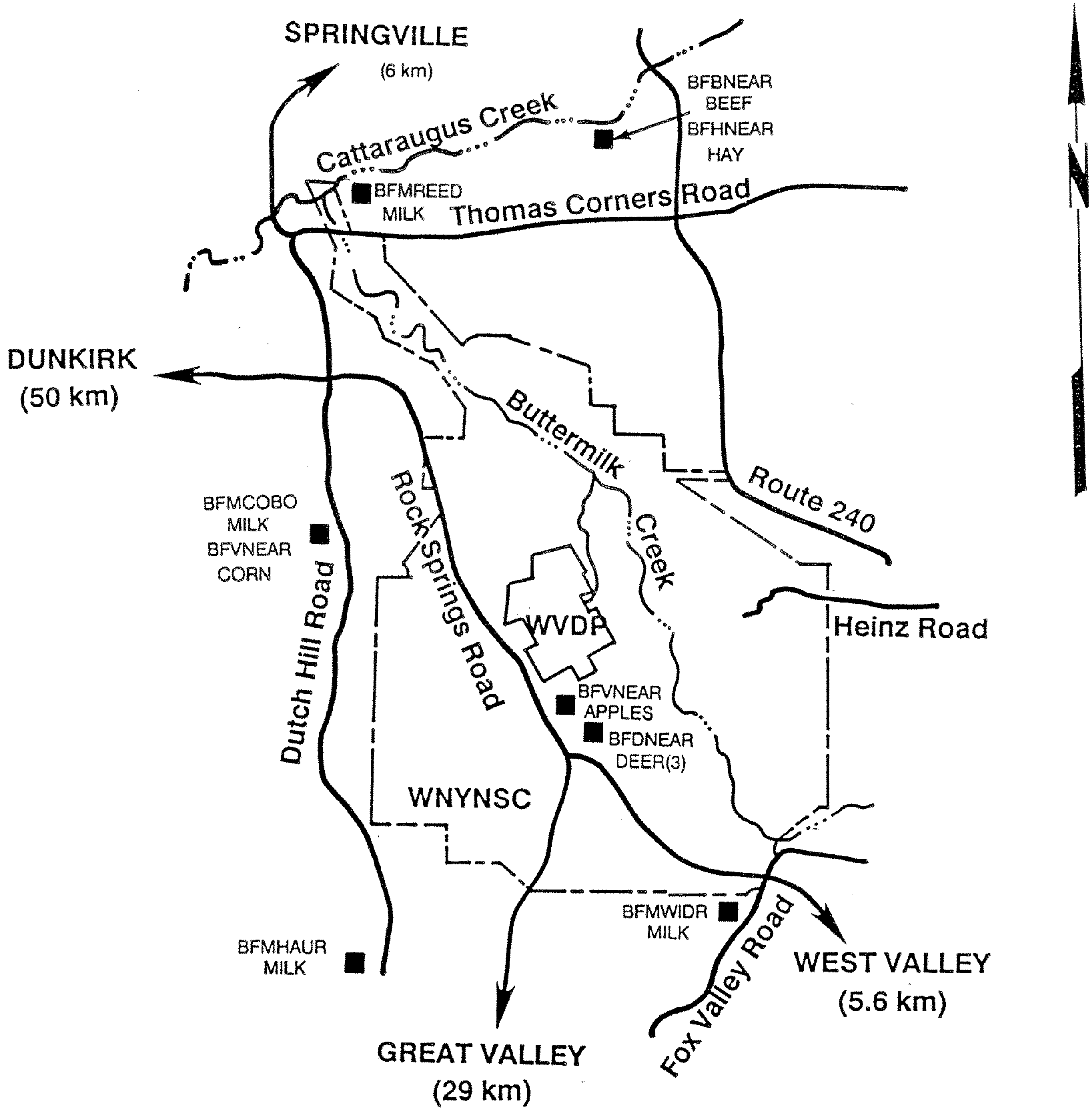


Figure 2-7. Biological Samples Taken Near the WVDP.

taken from herds to the south (BFMWIDR) and southwest (BFMHAUR). Two samples from control herds (BFMCTRLN and BFMCTRLS) were also collected as quarterly composites. Each sample or composite was analyzed for strontium-90, tritium, iodine-129, and gamma-emitting isotopes (Table C-3.1). Strontium-90 in samples from near the site ranged from 1.5 to 6.5 E-9 μCi/mL (5.6 E-2 to 2.4 E-1 Bq/L) compared to the control samples at 1.4 to 3.4 E-9 μCi/mL (5.2 E-2 Bq/L to 1.3 E-1 Bq/L). Iodine-129 was not detected in any samples to the lower limit of detection (LLD) of 7 E-10 μCi/mL (2.6 E-2 Bq/L). Due to a change in contract laboratories for the last half of 1988, the LLD for iodine-129 increased to 4.0 E-9. Cesium-137 and other gamma-emitting fuel cycle isotopes were also not detected. Tritium was added to the analyses performed, with all results below the detection limit of 3.5 E-7 μCi/mL (1.3 E1 Bq/L).

Based on the samples analyzed in 1988 (Table C-3.3), there was no detectable difference in the concentration of tritium or gamma-emitting isotopes in corn, apples, or tomatoes grown near the site and at remote locations. Samples of tomatoes and corn from both near the site and remote locations showed no overall difference in strontium-90. However, apples from the WNYNSC contained strontium-90 at very low concentrations, but slightly above those grown in unrestricted locations (see Figure 2-7). There was no detectable difference in the concentration of gamma-emitting isotopes or strontium-90 in hay near the site and at remote locations.

Section 4 of this report discusses the radionuclides present in the human food chain and assesses their contribution to the potential for radiation exposure to the public. Although the maximum concentrations of radioactivity found in some biological samples were above background levels, the potential dose associated with consumption of these samples is far below the protection standards.

2.1.4 Direct Environmental Radiation

The current monitoring year, 1988, was the fifth full year in which direct penetrating radiation was monitored at WVDP using TL-700 lithium fluoride (LiF) thermoluminescent dosimeters (TLDs) located as shown on Figures 2-6, 2-8 and 2-9. The uncertainty of individual results and averages were acceptable and measured exposure rates were comparable to those of 1987. There were no significant differences in the data collected from the background TLDs (locations 17 and 23) and from those on the WNYNSC perimeter for the 1988 reporting period.

Dosimeters used to measure ambient penetrating radiation during 1988 were processed on-site. The system used Harshaw TL-700 LiF chips which are maintained solely for environmental monitoring apart from the occupational dosimetry TLDs. The environmental TLD package consists of five TLD chips laminated in a thick card bearing the location identification and other information. These cards are placed at each monitoring location for one calendar quarter (3 months) and then processed to obtain the integrated gamma radiation exposure.

Monitoring points are located around the site perimeter and access road, at the waste management units, at the inner facility fence, and at background locations remote from the WVDP site. Appendix C-4 provides a summary of the results for each of the environmental monitoring locations by calendar quarter along with averages for comparison.

The quarterly averages and individual location results show very slight differences due to seasonal variation. During the first quarter (January through March) of 1988, the average quarterly exposure was decreased due to spring snow cover. The second quarter (April through June), third quarter (July through September), and fourth quarter (October through December) with no snow cover had a higher quarterly average. The data obtained for all four quarters compared favorably to the respective quarterly data in 1987 with no unusual situations observed. A comparison of the 16 perimeter TLD quarterly averages since 1983 is shown in Figure 2-10. The perimeter TLD average was 21.3milli Roentgen/quarter (20.4 mrem/qtr.) for 1988.

Presumably because of their proximity to the LLW disposal area, the dosimeters at locations 18 and 19 showed a small elevation in radiation exposure

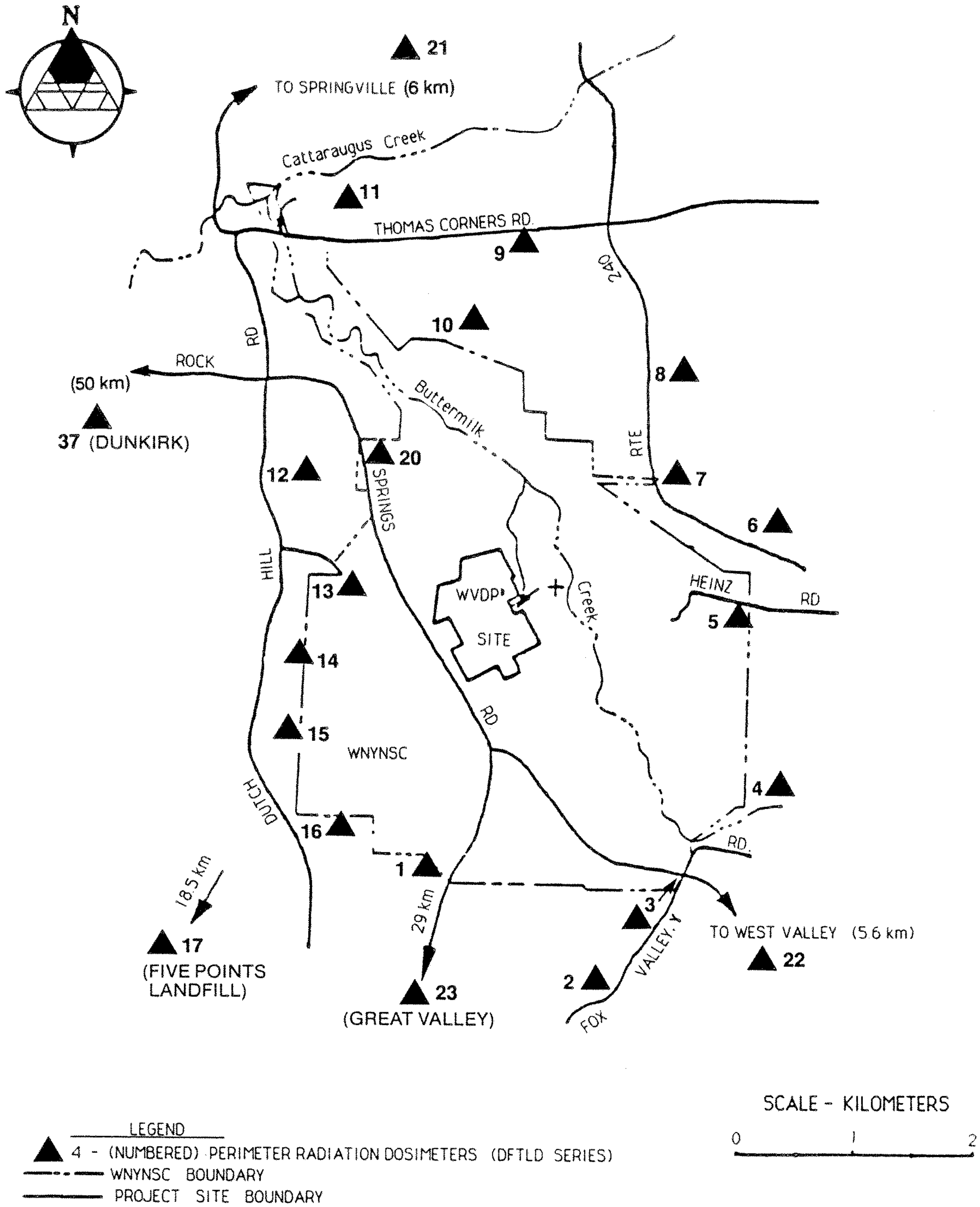


Figure 2-8. Locations of Perimeter Thermoluminescent Dosimetry (TLD).

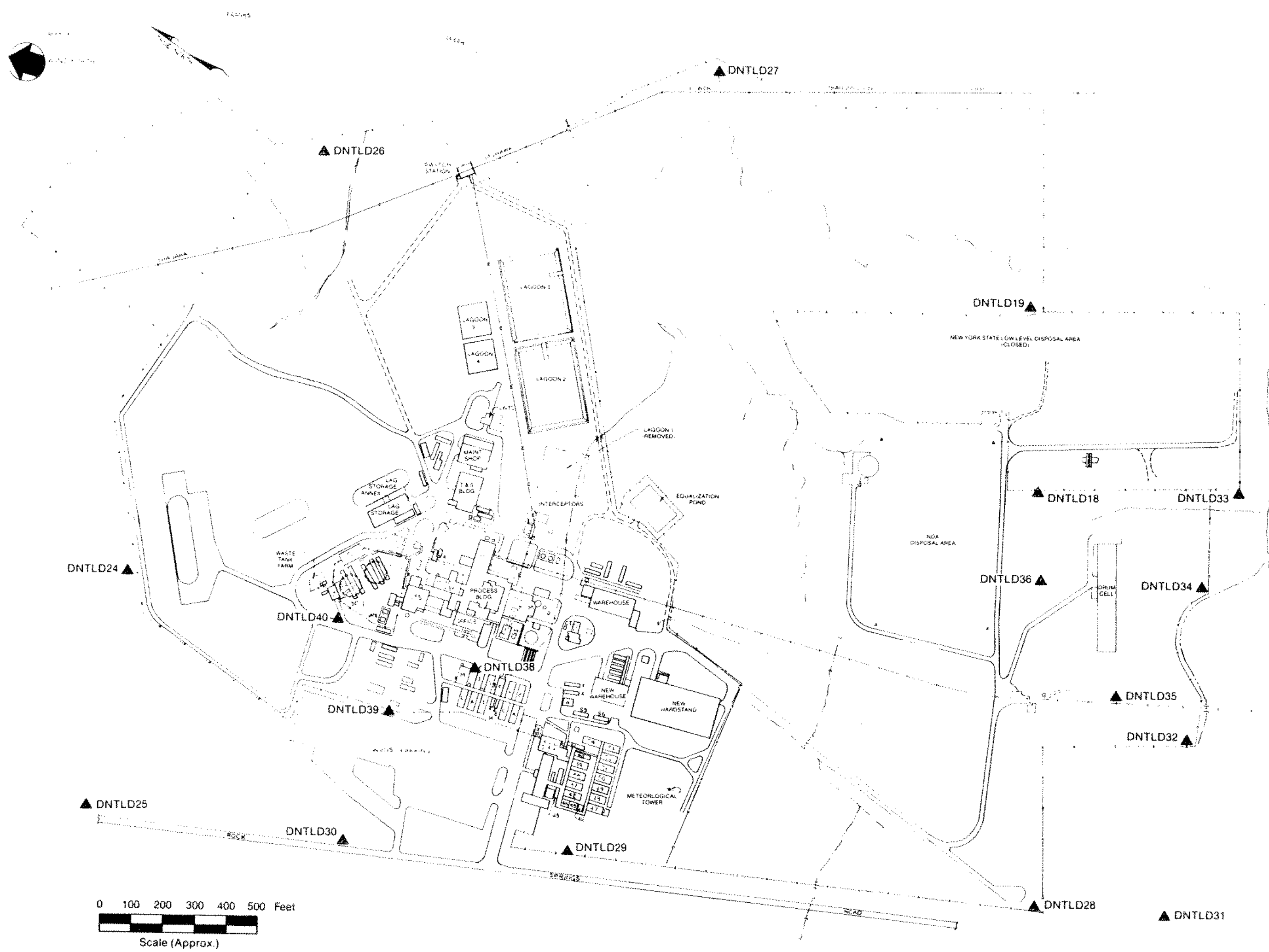


Figure 2-9. Locations of On-Site Thermoluminescent Dosimetry (TLD).

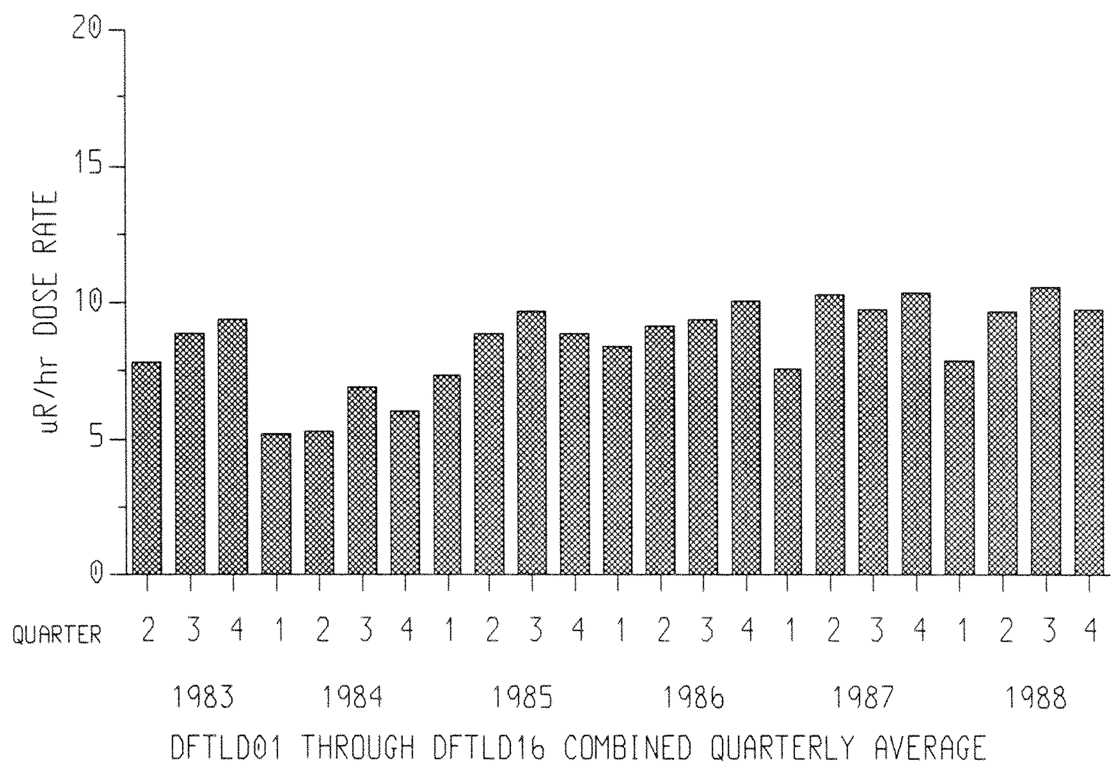


Figure 2-10
Average quarterly gamma exposure rates around the WVDP

compared to the WNYNSC perimeter locations. Although above background, the readings are relatively stable from year to year. Location 25, on the public access road through the site north of the facility, also showed a small elevation above background due to the storage of decontamination wastes near location 24 within the site security area.

Location 24 on the north security fence, like locations 18 and 19, is not included in the off-site environmental monitoring program; however, it is a co-location site for the NRC TLD (Table D-1.7). This point received an average exposure of 0.79 mR per hour during 1988. This exposure is primarily attributable to the nearby storage of sealed containers of radioactive components and debris from plant decontamination efforts. The storage area is well within the WNYNSC boundary and not readily accessible to the public. TLD locations 26 through 36 are located along the Project security fence, forming an inner ring of monitoring around the facility area. TLDs 37 through 40 were added in 1987 to monitor a third background location and to improve coverage of waste management units and on-site sources.

2.2 NONRADIOLOGICAL MONITORING

West Valley Demonstration Project effluents are regulated for nonradiological parameters by NYSDEC. Stationary sources of atmospheric pollutants are authorized by either a permit to construct or a certificate to operate. Liquid effluents are monitored as a requirement of the State Pollution Discharge Elimination System (SPDES) permit issued and enforced by the NYSDEC. A summary of nonradiological monitoring is provided in Appendix C-5.

2.2.1 Air Discharges

The WVDP presently holds six certificates to operate stationary sources and one permit to construct a new source of airborne effluents. These permits are for minor sources of regulated pollutants such as particulates, nitric acid mist, and oxides of nitrogen. Monitoring these parameters is not required because of their insignificant concentrations and small mass discharge.

The individual air permits held by the WVDP are identified and described in Table C-5.1.

2.2.2 Liquid Discharges

The WVDP holds a SPDES permit which identifies the outfalls where liquid effluents are released to Erdman Brook (shown in Figure 2-11) and which specifies the sampling and analytical requirements for each outfall. This permit was modified in 1988 to include additional monitoring requirements at outfall 001.

Three outfalls are identified on the permit: outfall 001, discharge from the LLWTF; outfall 007, discharge from the sanitary and utility effluent mixing basin; and outfall 008, effluent from the perimeter of the low-level waste treatment facility storage lagoons. The conditions and requirements of the current SPDES permit are summarized in Table C-5.2.

The most significant features on the SPDES permit are requirements to report data as flow-weighted concentrations and to apply a "net" discharge limit for iron. The net limit allows for subtraction of incoming naturally present amounts of iron in the project's effluent. The flow-weighted limits apply to the total discharge of project effluents but allow maximum credit for dilute waste streams in determining compliance with effluent concentration limits specified in the permit.

2.2.3 Results

The SPDES monitoring data are displayed in Figures C-5.2 through C-5.31. Project effluents were, for the most part, within permit limits. However, the WVDP reported a total of 24 non-compliance episodes in 1988. These are listed on Table C-5.3.

2.3 POLLUTION ABATEMENT PROJECTS

As 1988 began, there were four ongoing pollution control and abatement projects carried over from 1987. Two of these projects were directed toward RCRA compliance and site characterization, and are continuing into 1989. A third project, revision and up-dating of the WVDP Spill Prevention, Control and Countermeasures Plan, was completed in 1988. The modified plan was issued in January 1989 as an addendum to the WVDP Emergency Plan and Procedures Manual (WVDP-022). The fourth project, upgrades to the sewage treatment plant, was completed on June 2, 1988.

One new project was undertaken during 1988. An asbestos survey of the plant was completed and asbestos-containing materials were identified. The results were reported in an Asbestos Inspection Report and Management Plan, which evaluated the hazards and assigned priorities for corrective action. The final report was issued in February 1989.

2.4 SPECIAL MONITORING

2.4.1 Closed Landfill Maintenance

Closure of the on-site nonradioactive construction and demolition debris landfill was accomplished in August 1986, although this facility had been removed from active service in 1985. The site was closed in accordance with NYSDEC requirements for construction and demolition debris landfills following a closure plan [Standish 1985] approved by NYSDEC. Routine inspection and maintenance of the closed facility was performed in 1988 as specified by the closure requirements. These activities included checking areas for proper drainage (i.e., no obvious ponding or soil erosion) and cutting the grass planted on the soil and clay cap.

2.4.2 STS System Air Monitoring

The Permanent Ventilation System (PVS) began operation in April 1988 to support the IRTS proces-

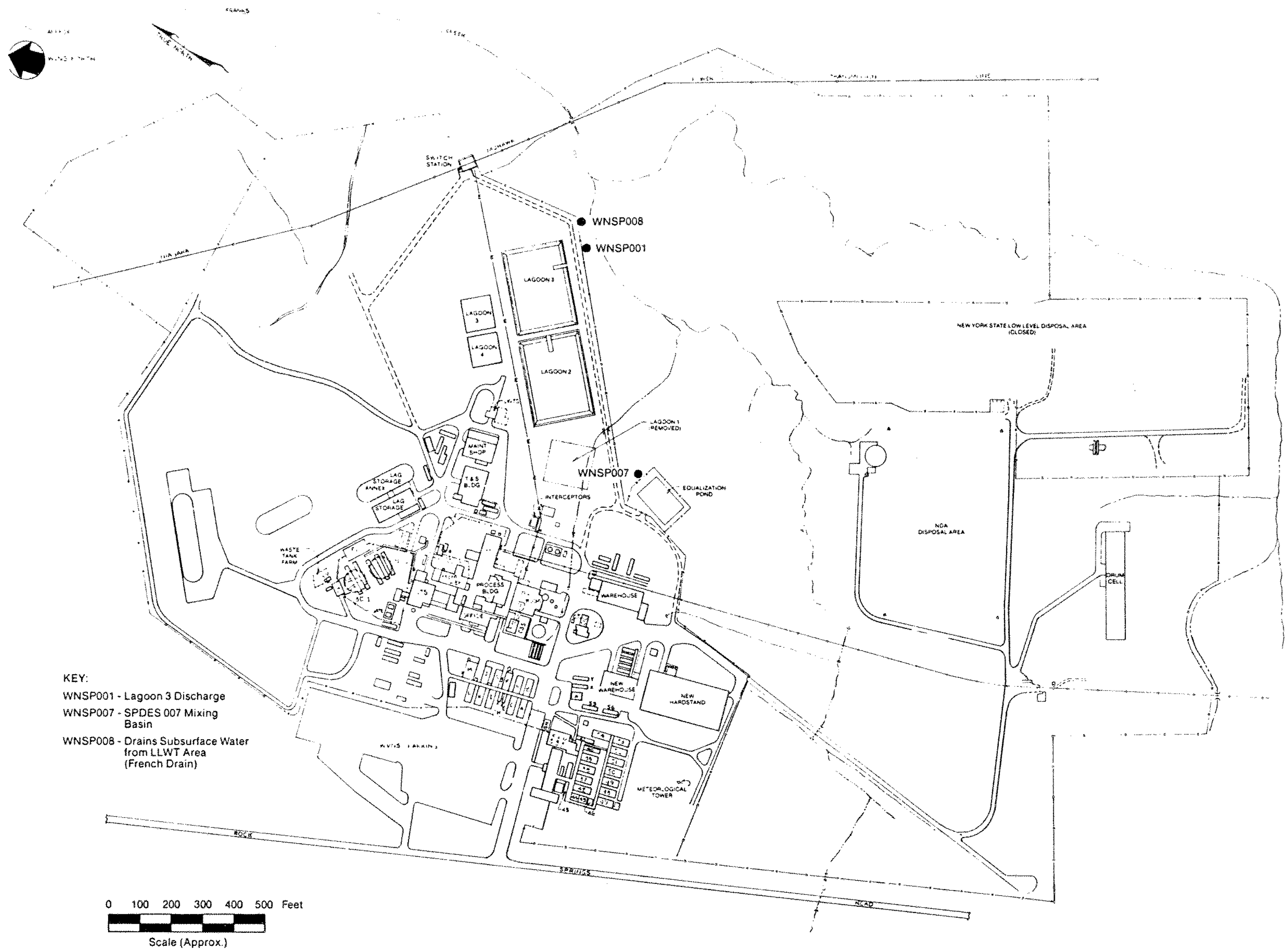


Figure 2-11. SPDES Monitoring Points.

ses. Located on the northeast corner of the high-level waste tank farm, the PVS consists of two redundant air monitoring systems, a sampling system, and special air flow regulating units designed to maintain isokinetic flow through all the components. Integrating air flow totalizers were also installed to record the total volume of air sampled and the total air volume released from the facility.

The PVS is designed to ventilate the STS building which houses process piping and the STS control room. However, the system also provides ventilation for the high-level waste tank farm. During the 1988 waste tank modifications for STS processing, the PVS ran a total of 46.4 hours, drawing from both the waste tanks and the STS building. For the remainder of the time, it has monitored only STS building air.

Each monitoring system detects gross alpha and gross beta activity using separate flow channels for each detector. A digital readout of filter activity is displayed in both the PVS building and the STS control room. Alarms are located both in the PVS and STS buildings to indicate monitor or system trouble, detector failure, and high radiation conditions. Radiation alarms are set to activate at one tenth the maximum allowable limits for air effluents, as stipulated in the Operational Safety Requirements. A second alarm will activate, if the allowable limit is reached. All data are permanently recorded on an attached six-pin chart recorder. The backup monitoring system is maintained in operating condition for use in the event of trouble or failure with the on-line system. The sampling system will operate continually, regardless of alarms or conditions associated with the monitoring system. Samples can be removed as needed to evaluate conditions, but the normal schedule for particulate and iodine filter change is weekly.

Operations of the STS require continuous routine monitoring of the PVS. After six process runs and waste tank modification work, the routine analysis of particulate air filters, charcoal cartridges, and tritium samplers indicated that activity levels were less than 1 percent of the DCGs for all measurable activities of each sampling medium. The monitoring and sampling schedule for this new system is provided in Appendix A (ANSTSTK). Results for 1988 are presented in Tables C-2.1.8 and C-2.1.9.

3.0 GROUNDWATER MONITORING PROGRAM

3.1 HYDROGEOLOGY OF THE SITE

The WVDP site lies within the Glaciated Allegheny Plateau section of the Appalachian Plateau Physiographic Province. The section is a maturely dissected plateau with surficial bedrock units of Devonian shales and sandstones. Bedding dips uniformly and gently (4 to 7.5 m/km) to the south. The plateau has been subjected to erosion and the deposits of repeated glaciations, resulting in accumulations of till (intermingled sand, silt, clay, gravel, and boulders), outwash, and lacustrine deposits over the area.

The site is underlain by a thick sequence of silty clay tills and a thinner layer of more granular deposits filling a bedrock valley that has been carved through Devonian shales by the precursor of Cattaraugus Creek and its tributaries. Figure 3-1 shows a generalized east-west cross section through the site. The uppermost till unit is the Lavery, a very compact gray silty clay. The Lavery is approximately 6 m (20 ft.) thick at the western boundary of the WVDP and thickens to the east. At the western edge of the developed portion of the WVDP, the Lavery is approximately 30 m (99 ft.) thick.

The upper 3 m (10 ft., approximately) of the Lavery have been chemically weathered by leaching and oxidation and mechanically weathered by biological processes. The hydraulic conductivity of the weathered till tends to be higher than that of the underlying, unweathered parent material, probably as a result of the much greater frequency of fractures in the weathered portion. *In situ* measurements of the hydraulic conductivity in the unweathered Lavery till have generally ranged between 10-8 and 10-7 cm/s.

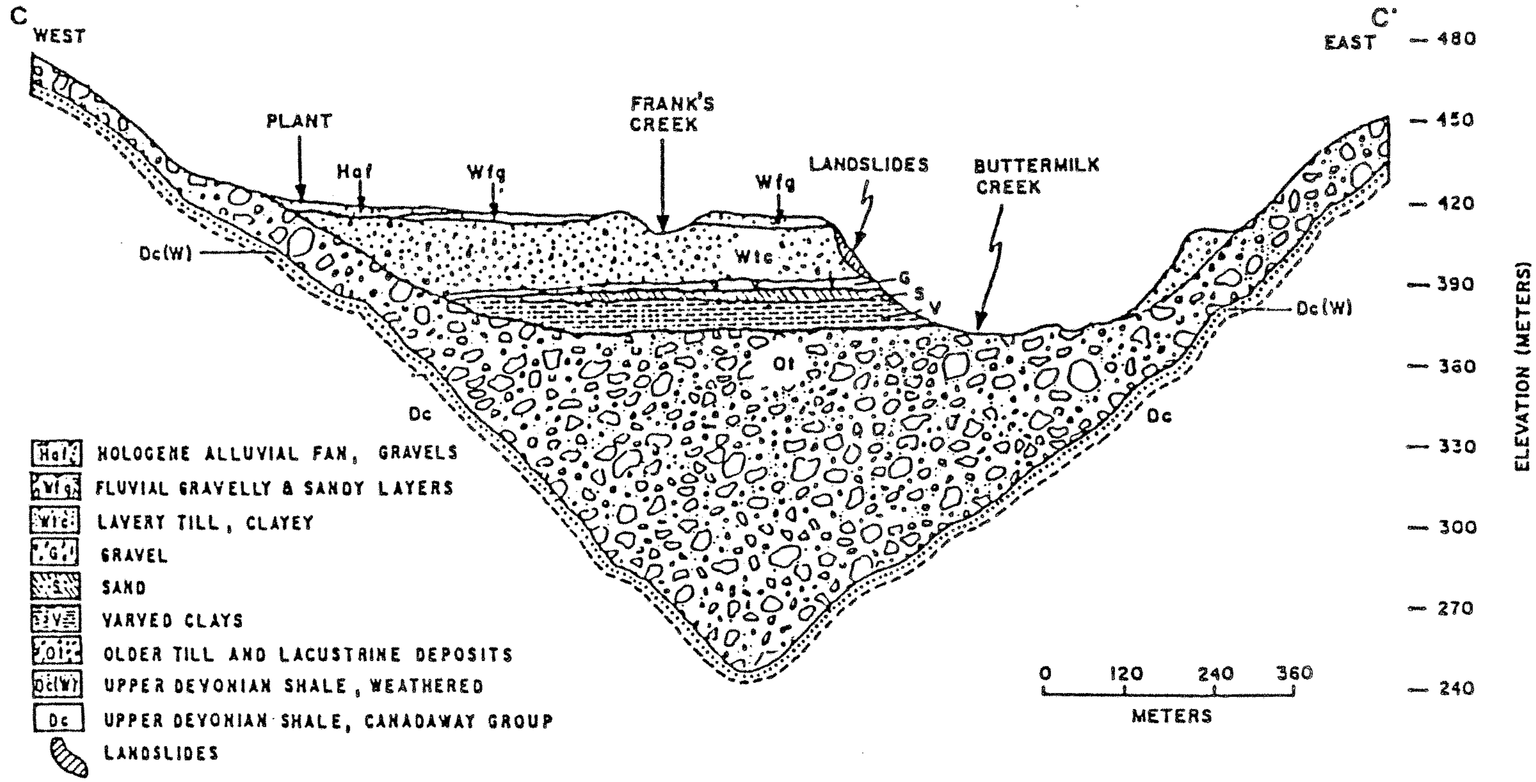
The northern portion of the WVDP site (the North Plateau) is blanketed by alluvium and glacial fluvial deposits that include sand and gravel layers. The Lavery till directly underlies these deposits.

Below the Lavery till is a more granular unit referred to locally as the Lacustrine Unit. It comprises silts, sands and, in some areas, gravels which overlie a layered (varved) clay. The Lacustrine Unit is believed to be more permeable than the Lavery, but little permeability testing has been performed in this unit. Hydraulic conductivities on the order of 10-5 to 10-4 cm/s are assumed for this unit. These values are conservative in view of the very fine-grained nature of the sandy beds that occur in the unit.

Groundwater flow beneath the site occurs in two aquifers and, to a considerably lesser extent, in the aquiclude (unweathered Lavery till) that separates them. The upper aquifer is a water-table aquifer in the weathered till in the southern portion of the site and in the alluvium and glacial fluvial deposits on the North Plateau. The water table in the weathered till tends to be transient, commonly existing only during the late winter and spring when considerable percolation into the unit occurs from the spring thaw. The primary flow in the weathered till occurs through the extensive system of fractures which has been observed in this unit.

The lower aquifer is an unconfined aquifer in the Lacustrine Unit. The piezometers tapping this unit all exhibit water levels below the top of this unit. The total recharge mechanism for the unit is not well defined because of limited data. Available data, however, suggest that the unit is probably recharged from the fractured bedrock and from downward seepage through the overlying Lavery till. The bedrock recharge zone to the west is recharged at outcrops in the uplands to the west of the site. Flow in the Lacustrine unit appears to be eastward to Buttermilk Creek.

The aquiclude that separates the two aquifers is the unweathered Lavery till. Its mass permeability is extremely low, but it does permit seepage. When the weathered till is acting as a transient aquifer, a vertical gradient of unity exists in the till and causes water to move downward, but at a very low rate.



NOTE:
Vertical scale = 1/4 horizontal scale.
Adapted from Dana et al. (1979a).

Figure 3-1. Generalized Geologic Cross Section at the West Valley Demonstration Project.

3.2 GROUNDWATER MONITORING PROGRAM OVERVIEW

The 1988 groundwater monitoring program consisted of two main sub-programs: on-site waste management unit and supporting on-site well monitoring and off-site drinking water well monitoring.

3.2.1 On-site Waste Management Unit Monitoring

A system of 14 wells, one groundwater seep, and a french drain outlet are included in the groundwater monitoring program for three separate waste management areas: Low-Level Radioactive Waste Lagoon System, High-Level Waste Tank Complex, and NRC-Licensed Disposal Area. The monitoring points are located around the waste management units, so that one point is hydraulically upgradient, and the remainder of the points within a given unit are hydraulically downgradient of the waste management unit. The locations of the monitoring points were selected based on known groundwater flow patterns for each of the three separate areas, and the presence and proximity of other potential sources of contamination. Comparisons between upgradient and downgradient locations allow for the detection of significant increases or changes in monitored groundwater contamination indicator parameters, as compared to upgradient conditions.

Low-level Radioactive Waste Lagoon System

Six monitoring wells are used to assess groundwater quality in the area of the low-level radioactive waste lagoon system. Well 86-6 serves as the upgradient well for this unit, while wells 80-5, 80-6, 86-3, and 86-4 are all downgradient wells. Well 86-5 is designed to monitor the groundwater quality in the immediate vicinity of former Lagoon 1, and is located downgradient of this former lagoon, in the direction of Erdman Brook. The outlet of the french drain (SPDES sampling point, WNSP008) and a groundwater seep (WNGSEEP), located along the western bank of Frank's Creek, are also included in the monitoring system for this unit. The french drain serves as a sink for surface groundwater in the immediate vicinity of the lagoon system, and provides a good indicator of groundwater quality over time. The french drain has been extensively sampled, and good long-term records are available for this location.

The groundwater seep (WNGSEEP) and wells 80-5 and 80-6 provide a measure of groundwater quality in the surficial deposits of the north plateau. The quantity of groundwater flowing beneath the lagoon system not diverted by the french drain is unknown. However, it is believed that some of the deeper groundwater, particularly on the northern sides of Lagoons 4 and 5, tends to flow generally northeastwardly towards Frank's Creek. A 1982 study of tritium in groundwater in the vicinity of the lagoon system provides evidence of this groundwater flow pattern. The locations of these monitoring sites are shown on Fig 3-2.

High-Level Waste Tank Complex

Four monitoring wells serve the high-level waste tank complex. Well 80-2 is located upgradient of the high level waste tank area, and wells 86-7, 86-8 and 86-9 are located hydraulically downgradient. These downgradient wells are located along the major groundwater flow paths passing through the tank complex, as determined by Yager [1987]. These sampling locations are shown on Fig 3-2.

Data for two additional groundwater sampling locations are reported along with data for the high-level waste tank complex to allow for comparison to a representative upgradient well. These locations, well 86-12 and the screened standpipe WNDMPNE, monitor the former non-radioactive construction and demolition debris landfill which was closed in 1986.

NRC-Licensed Disposal Area

Four wells are used to monitor the NRC-licensed disposal area. All four wells are screened within the Lacustrine Unit. Well 83-1D serves as the upgradient well for this unit. Wells 86-10, 86-11, and 82-1D serve as downgradient wells. Well 82-1D is normally dry, and was not sampled during 1988. The locations of these wells are shown on Fig 3-2.

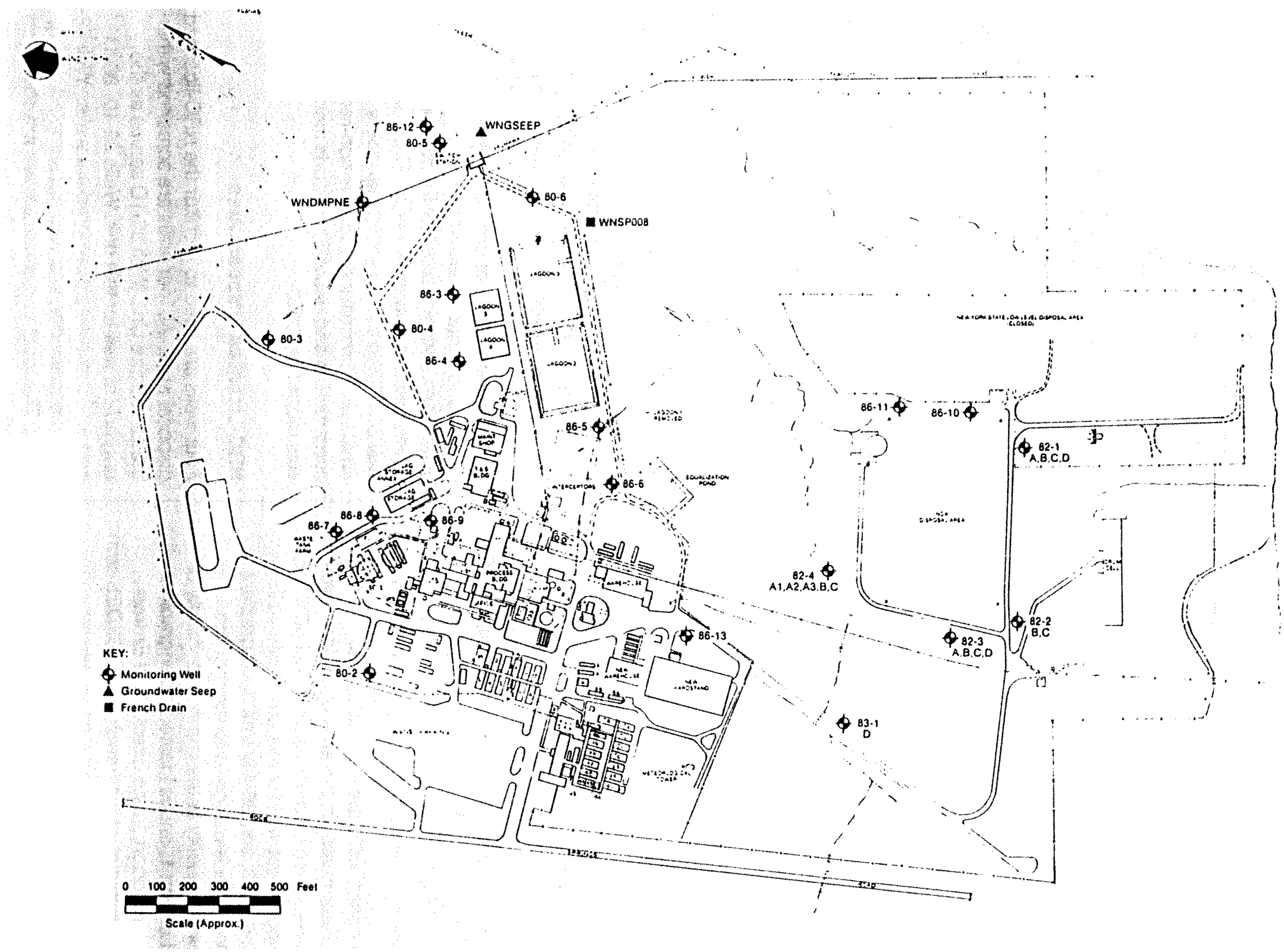


Figure 3-2. Location of On-Site Groundwater Monitoring Points

Waste Management Unit Sampling

All site wells comprising the waste management unit groundwater monitoring program were sampled three times during 1988. The first sampling period was during the first quarter of 1988 and is referred to in the data tables as 8801. Data from this sampling effort were used to complete background groundwater characterization of the waste management units. The second sampling period took place during the second and third quarters of 1988, and is designated by the code 8810. The third and final sampling period for 1988 was during the fourth quarter of 1988, and is referred to as period 8820. These latter two sampling periods correspond to the first and second semi-annual sampling periods following background characterization. The latter period was completed during one calendar quarter in order to include the data in this report, and to allow subsequent semi-annual sampling to follow the calendar year.

Prior to each sampling effort each well is sounded, a small sample is collected for radiological screening purposes, and the volume of standing water within the well casing is calculated. At the time of sampling, each well is first purged (evacuated) of at least three well casing volumes of water (one casing volume, if the well goes dry), using dedicated bailers, dedicated sampling equipment, or thoroughly cleaned equipment. (Dedicated equipment was used for all wells sampled during period 8820). Following well purging, four replicate samples are collected for each of the parameters listed in Table 3-1. Measurement of pH is performed in the field on four samples from each well, two of which are collected at the beginning of the sampling cycle, and the remaining two after all other replicate samples have been collected. This pH measurement procedure provides an indication of the homogeneity of the sampled groundwater. Samples collected for dissolved metals are filtered in the field, as the sample is obtained. Samples for total metals are also collected.

Following collection, the samples are brought to the Environmental Laboratory where proper preservation, required for certain parameters, is performed. Samples to be analyzed by off-site laboratories are shipped via overnight courier in insulated shipping containers. Samples analyzed on site are held in controlled storage until time of analysis.

Groundwater Contamination Indicator Parameters

Those parameters which serve as indicators of groundwater contamination at the WVDP are shown on Table 3-1. These indicators were selected after considering the type, quantities, and concentrations of constituents in the waste at the Project, in addition to their mobility, persistence, and detectability. These parameters are sensitive indicators of groundwater quality and at the same time are representative of wastes existing within the waste management units.

A One-Way Analysis of Variance (ANOVA) was performed for each indicator parameter for each of the three waste management units using a commercially available statistical software package [STATGRAPHICS, Statistical Graphics Corporation]. The ANOVA technique is recommended [USEPA 1989] as one of several methods suitable for comparing upgradient to downgradient groundwater monitoring data. This statistical analysis was used to compare the means for each parameter for each well within a given waste management unit to determine whether samples are derived from the same source. Once significant differences are discovered, comparisons are then made to determine which, if any, well locations are significantly different from the upgradient monitoring location.

3.2.2 Supporting Monitoring Wells and Off-site Wells

In addition to the on-site monitoring wells described above, a number of other wells (WNW80 and WNW82 Series) are sampled on a semi-annual basis. These wells are sampled for radioactivity and selected water quality parameters as indicated in Appendix E. Locations of these wells are shown in Figure 3-2 along with the wells in the waste management monitoring program.

Well 86-13, located near the below-ground gasoline and diesel fuel storage area, was sampled on the same schedule as the waste management

TABLE 3-1

SCHEDULE OF GROUNDWATER SAMPLING AND ANALYSIS

Category	Parameter	Frequency	Comment
1. EPA Interim Drinking Water Standards	Arsenic Barium Cadmium Floride Lead Mercury Nitrate (as N) Selenium Silver Radium Gross Alpha Gross Beta	Quarterly for 1st year.	Annually after 1st year except coliform and pesticides
	Coliform Bacteria Endrin Lindane Methoxychlor Toxaphene 2,4-D 2,4,5-TP Silvex		These were omitted because site history does not indicate past usage or potential for contamination
II. Groundwater Quality Indicators	Chloride Iron Manganese Phenois Sodium Sulphate	Quarterly for 1st year, annually thereafter	
III. Groundwater Contamination Indicators	Nitrate pH Conductivity Total Organic Carbon Total Organic Halogens Specific Metals Tritium Gross Alpha Gross Beta Specific Gamma Emitters	Quarterly for 1st year, semiannually thereafter	All parameters are measured in 4 replicates of each sample. Parameters selected by WVNS as indicators of waste treatment/disposal at WVDP.
IV. Groundwater Elevations		Once before collecting each well sample	

unit wells. Samples were analyzed for volatile organic fuel products, radioactivity, and selected water quality parameters. The location of this monitoring point is shown on Figure 3-2.

Private residential drinking water wells around the site restricted area represent the nearest unrestricted use of groundwater near the Project. These potable water wells are monitored primarily for radioactivity. One half of the wells in this group are sampled one year, the other half the next year. Locations of the wells are shown on Figure 3-3.

3.3 GROUNDWATER MONITORING RESULTS

3.3.1 Statistical Treatment of Data for Waste Management Units

The waste management unit groundwater data obtained from the collection of four replicate samples for each parameter was averaged using Cohen's Method [USEPA 1986]. This method provides a maximum likelihood estimate of the mean for data consisting of a mixture of detectable and below detection limit values (censored data). Cohen's Method assumes the censored data follow a normal distribution. When all four replicate values were greater than the limit of detection, a straight arithmetic average was used. When all replicate values were less than the detection limit, the value assigned was that of the detection limit. All radiological data were exempted from this procedure and were averaged using the actual available counting results. Averaged radiological data which were then below the 95% counting error were assigned less-than-detection limit values.

The averaged data for all the parameters measured for the waste management unit monitoring program wells are tabulated and presented in Appendix E. Graphical presentation of the 99% confidence interval about the means is also presented in Figures E-1 through E-41 for the groundwater contamination indicator parameters and selected water quality parameters. These plots were generated by the ANOVA routine, and the confidence interval provided assumes equal variances for all wells within a group. Thus the error bars around each mean value are of equal size.

The results of the ANOVA technique performed for each of the selected contamination indicator parameters for each of the three waste management units are presented in the following sections. This analysis included data from 1987 through 1988. Several of the ANOVA conclusions are derived from log transformed data in order to stabilize or equalize variances between sample locations. Strict agreement between the 99% confidence interval plots and the results shown in the statistical summary tables does not always occur, because all the confidence interval plots shown in Appendix E were derived from non-transformed data. Log transformed plots were not shown because they are not easily interpreted. In the few cases where agreement does not occur, the results shown in the summary tables are more conservative.

The statistical summary tables in this section present differences observed for indicator parameters at downgradient locations as compared an upgradient monitoring point for each of the three waste management units. Upgradient conditions represent background data for each of the monitored units. The terms "inc," "dec," "same," and "no" are used in the tables in the following manner.

Increase (inc) indicates that concentrations at the monitored downgradient points are statistically greater than at the upgradient location. Likewise, decrease (decr) indicates that downgradient concentrations are lower than upgradient values. The term "decr" is used only for pH, for which both decreases and increases are of concern. The term "same" indicates that no significant difference between upgradient and downgradient values was observed, and the term "no" indicates that downgradient concentrations are either statistically the same as or less than upgradient values. Significant decreases are not indicated for parameters other than pH, because they are not indicative of contamination.

It is important to note that the above terms do not indicate a trend within a particular well, but rather they provide information about differences be-

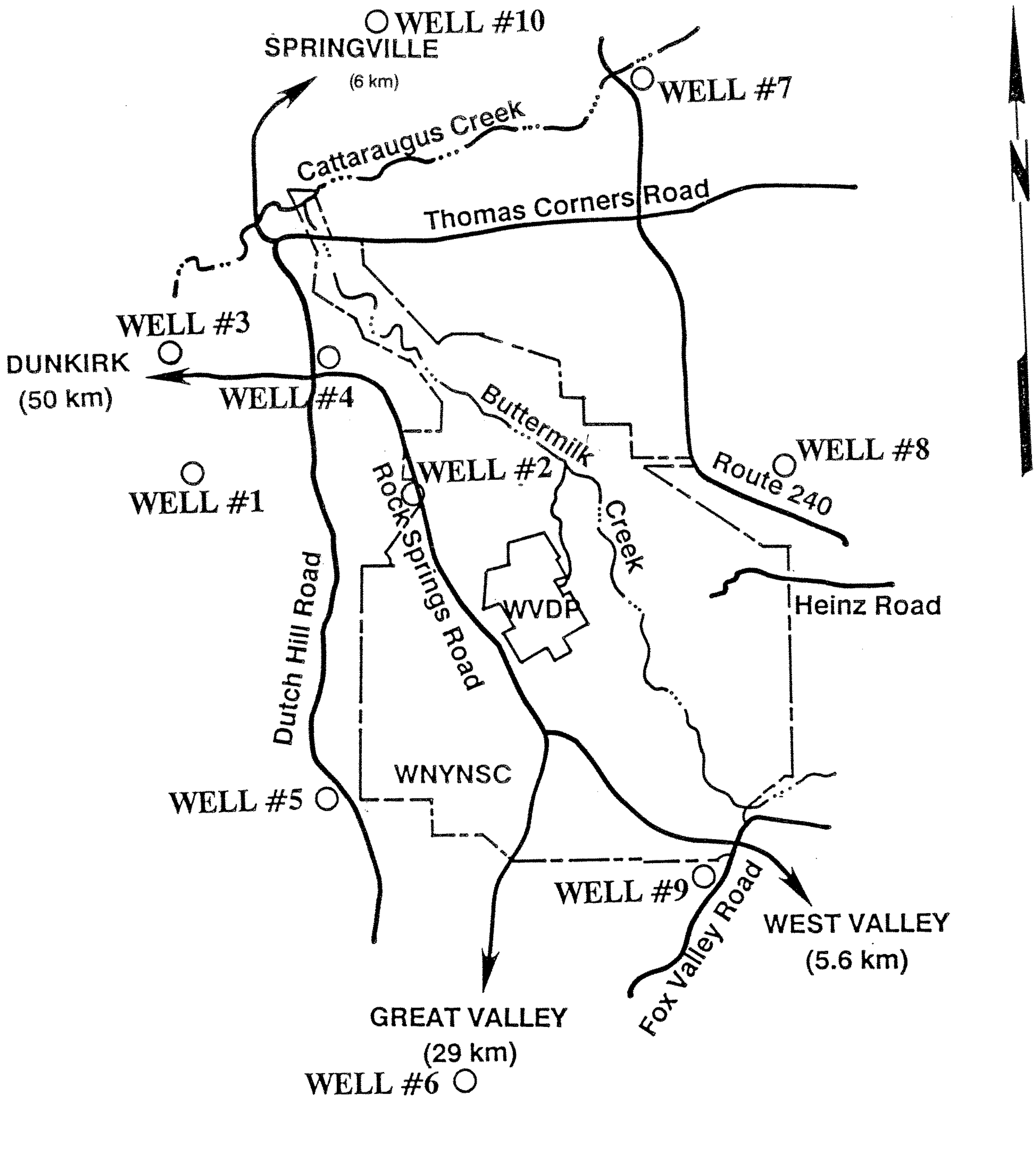


Figure 3-3. Off-Site Groundwater Wells.

Table 3-2
Statistical Summary of Groundwater Monitoring Data from Low-Level Radioactive Lagoon Area: Differences Observed at Downgradient Wells Compared to Well WNW86-6

Parameter	WNGSEEP	WNSP008	WNW80-5	WNW80-6	WNW86-3	WNW86-4	WNW86-5
pH	same	same	same	decr	inc	inc	same
conductivity	no	no	no	no	no	no	no
Nitrate-N	no	no	no	no	no	no	no
TOC	no	no	no	no	no	no	no
Barium	no	no	no	no	inc	inc	no
Manganese	no	no	no	inc	no	no	inc
Sodium	no	no	no	no	no	no	no
Tritium	inc	inc	inc	inc	inc	inc	inc
Gross beta	no	inc	no	no	no	inc	inc
Gross alpha	no	no	no	no	no	no	inc
Cesium-137	no	no	no	no	no	no	no
Cobalt-60	no	no	no	no	no	no	no

Notes: For pH, "same" indicates no change, "decr" indicates decrease.
For all parameters, "no" indicates lack of significant increase, and "inc" indicates increase as compared to upgradient location.

tween upgradient (background) and downgradient monitoring data. In all cases, significance was judged at the 99% confidence interval.

3.3.2 Low-Level Radioactive Waste Lagoon System

Table 3-2 presents the statistical summary results for the Low-Level Radioactive Waste Lagoon system monitoring unit. The only significant differences in pH between upgradient and downgradient locations occurred for wells 80-6, 86-3, and 86-4. The range for pH in this monitoring unit for 1988 was 6.22 (well 80-6) to 7.52 (well 86-3) which is within the range found in natural systems in the area. Only minor increases were noted for two other chemical indicator parameters (barium [Ba] and manganese [Mn]). The cause of these differences is unknown.

The following codes have been used in the tables and plots that follow: 8701 through 8704 correspond to the four quarterly sampling periods of 1987; and 8801, 8810, and 8820 correspond to the first quarter of 1988, the first semi-annual of 1988, and the second semi-annual sample period of 1988, respectively.

Significant differences were observed for tritium at all the downgradient monitoring locations. This is easily explained, since tritium was consistently below the detection limit of 1 E-7 μCi/mL at upgradient well 86-6, while it was consistently detected at levels ranging from 2.8 E-7 to 1.9 E-5 μCi/mL at downgradient monitoring locations (see Figure 3-4 and Table E-10).

Differences (inc) in gross beta levels relative to the upgradient well were noted over a much smaller area than for tritium, and occurred at locations WNSP008, 86-4, and 86-5 (Figure 3-2). Increased gross alpha activity, as compared to upgradient groundwater, occurred only at well 86-5.

Neither cesium-137 nor cobalt-60 was detected in any of the groundwater samples collected in this or any other waste management unit. (See tables in Appendix E for detection limits.)

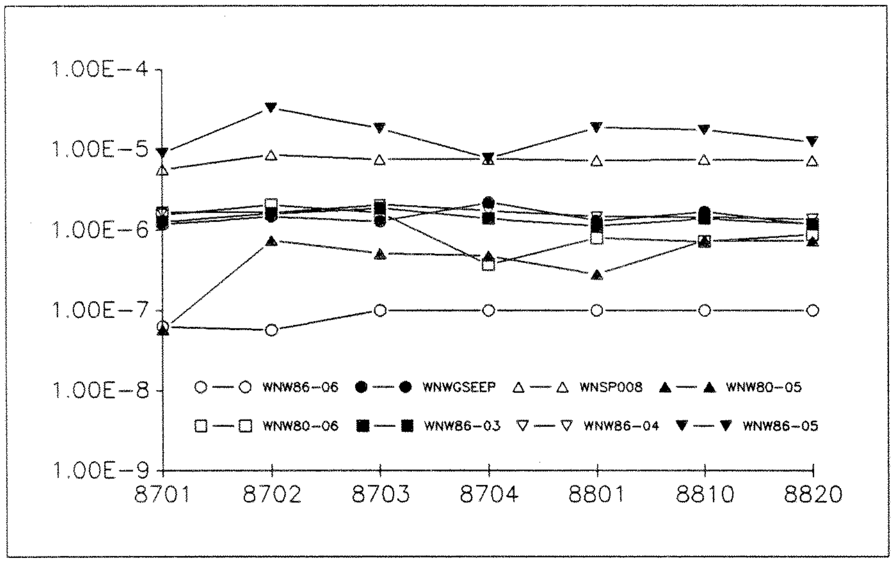


Figure 3-4
Comparison of tritium concentrations (μCi/mL) in 1987 and 1988 samples from wells near the Low-Level Radioactive Waste Lagoon Area. (Note log scale.)

The data from groundwater monitoring in the Low-Level Radioactive Lagoon System seem to indicate that wastes in this unit have influenced groundwater quality in the localized area surrounding the lagoons. Tritium was detected at levels significantly greater than at the upgradient location. During 1982 and since, tritium has been monitored in groundwater in the North Plateau region which includes the lagoon system. Monitoring during 1982 indicated that Lagoon 1 was a likely source of tritium contamination to the groundwater in this vicinity. Tritium activity within Lagoon 1, while it was in use, was at times as high as 1 E-1 μCi/mL, and provided a localized point source for potential contamination. During the 1982 study, tritium concentration gradients in groundwater suggested that the flow path in this North Plateau region was northeasterly towards the western bank of Frank's Creek [Marchetti 1982]. These observations caused Lagoon 1 to be removed from active service in 1984.

Since that time it appears that the level of tritium contamination in groundwater in the vicinity of the lagoon system has steadily decreased. Figure 3-5 shows the 7-year history of tritium concentration in WNSP008. Tritium concentrations at this groundwater monitoring location have decreased from about 4 E-5 μCi/mL in 1982 to 7 E-6 μCi/mL in 1988. This represents approximately a six-fold decrease in concentration over this 7-year period. Thus the concentration of tritium is decreasing at a rate about 4 times greater than expected from the 12.3-year radiological half life. This suggests that the former Lagoon 1 may have been influencing groundwater quality within this region. However, wastes treated in the Low-Level Waste Treatment Facility have also contained reduced levels of tritium, ranging from 5.8 E-6 to 4.5 E-5 μCi/mL in the discharge of Lagoon 3 during the period from 1986 to 1988. Thus, the actual impact of the closure of Lagoon 1 is difficult to evaluate.

Groundwater monitoring during 1988 at well 86-5, located immediately downgradient of the former Lagoon 1, yielded tritium concentrations similar to

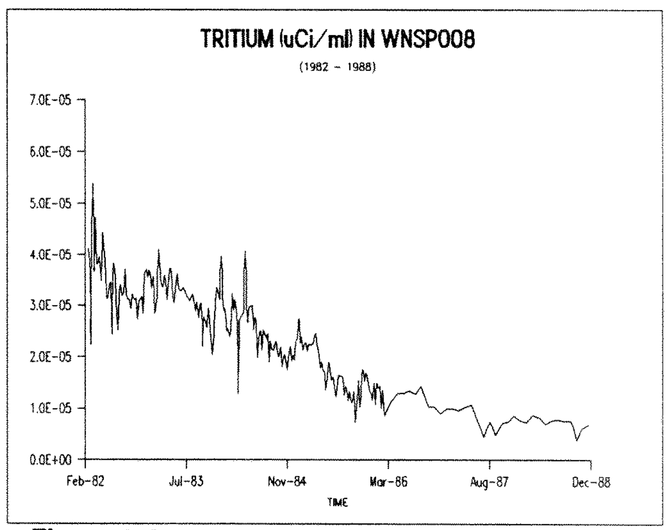


Figure 3-5
Tritium concentrations over the last 7 years at the Low-Level Radioactive Lagoon System Waste Management Unit monitoring point, WNSP008.

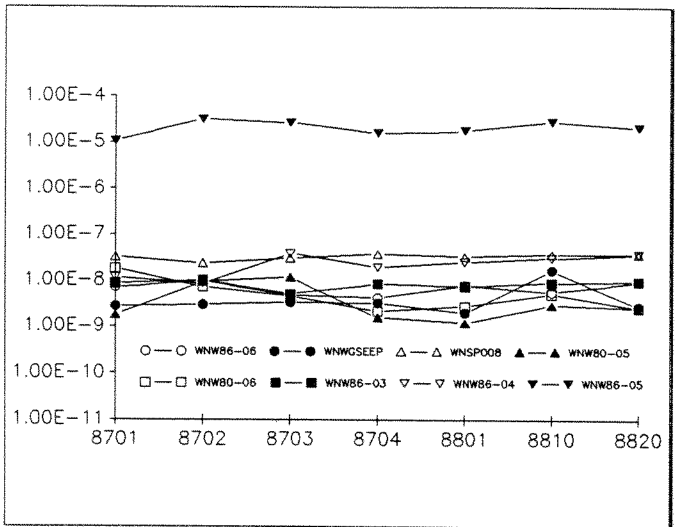


Figure 3-6
Comparison of gross beta concentrations (μCi/mL) in 1987 and 1988 samples from wells near the Low-Level Radioactive Waste Lagoon Area. (Note log scale.)

data obtained during 1987 (shown in Figure 3-4). Likewise, gross beta activities at this location remained relatively high, ranging from 1.8 E-5 to 2.8 E-5 μCi/mL as shown in Figure 3-6. Measurement of strontium-90 on a sample collected in

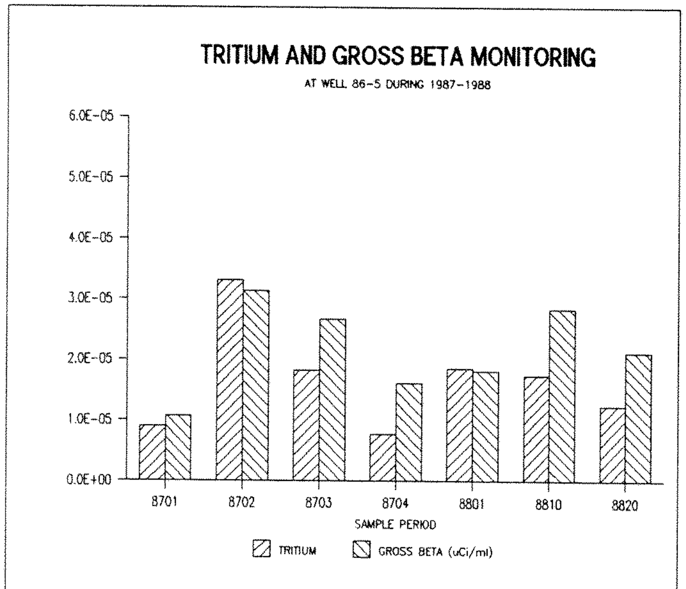


Figure 3-7
Tritium and gross beta monitoring results from Well 86-5 in the Low-Level Radioactive Waste Lagoon Area.

1987 (7.76 E-6 μCi/mL) indicated that most of the gross beta activity (1.61 E-5 μCi/mL) could be attributed to strontium-90, if assumed in equilibrium with its decay product, yttrium-90. Figure 3-7 presents the data for tritium and gross beta activity at well 86-5 during 1987 and 1988. Additional monitoring is underway in the immediate vicinity of former Lagoon 1 to fully assess the extent of contamination in this localized region.

One additional observation within this waste management unit is the consistent difference in conductivity between upgradient well 86-6 and the downgradient wells in this unit. Conductivity for the upgradient well is consistently much greater than that observed for any of the downgradient locations (see Figures 3-8 and Table E-7). It appears that groundwater in the immediate vicinity of well 86-6 is being affected by sodium and chloride ions, which are both mobile and soluble. The source of these ions may be the two sludge ponds south of well 86-6.

The radiological characteristics of well 86-6 do not appear significantly influenced by this higher level of conductivity. However, the suitability of this well

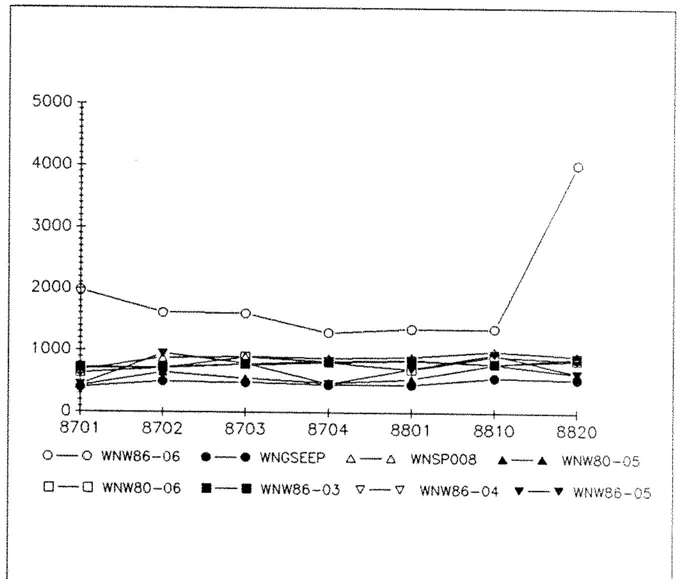


Figure 3-8
Comparison of conductivity (μmhos/cm @ 25 °C) in 1987 and 1988 sampling results from wells near the Low-Level Radioactive Waste Lagoon area.

to serve as the upgradient well for the lagoon monitoring system is currently under review.

3.3.3 High Level Radioactive Waste Tank Complex

Significant differences between upgradient and downgradient monitoring locations within this waste management unit are shown in the statistical summary Table 3-3. These differences are similar to those monitored during 1987. The two-year trend for tritium and gross beta at well 86-9, which exhibited the greatest number of significant differences between upgradient and downgradient well locations, is shown in Figure 3-9. These data indicate that little change has occurred at this locations over the two-year period. Data for pH and conductivity for upgradient well 80-2 and downgradient well 86-9 (Figures 3-10 and 3-11) were relatively stable during 1987 and 1988. It is pertinent to note that the bulk of the high-level waste is stored under alkaline conditions. Thus, leaks from this tank would cause increases rather than the observed decreases in downgradient pH values. Further, tank monitoring data do not indicate tank leakage.

3.3.4 NRC-Licensed Disposal Area Monitoring Unit

Table 3-4 shows that the only significant differences observed between upgradient and downgradient monitoring locations in the NRC-Licensed Disposal Unit were for conductivity, caused in part by increased dissolved sodium concentrations. These differences may be a result of variances in well depths of 17.1m (56 ft.) for well 83-1D and 35.7 m (117 ft.) and 35 m (115 ft.) for downgradient wells 86.10 and 86.11 respectively.

No significant differences were observed for any of the monitored radiological parameters within this unit.

Table 3-3

Statistical Summary of Groundwater Monitoring Data from High-Level Radioactive Waste Tank Complex Area: Differences Observed at Downgradient Wells Compared to Upgradient Well WNW80-02

Parameter	WNW86-7	WNW86-8	WNW86-9	WNW86-12*	WNDMPNE*
pH	decr	decr	decr	same	decr
Conductivity	inc	inc	inc	inc	inc
Nitrate-N	no	no	inc	no	no
TOC	no	no	no	no	no
Barium	no	no	inc	inc	no
Manganese	inc	inc	no	no	no
Sodium	inc	no	no	inc	inc
Tritium	no	inc	inc	inc	inc
Gross beta	inc	inc	inc	no	inc
Gross alpha	no	no	inc	no	no
Cesium-137	no	no	no	no	no
Cobalt-60	no	no	no	no	no

Notes: For pH, "same" indicates no change, "decr" indicates decrease.
For all parameters, "no" indicates lack of significant increase, and "inc" indicates increase as compared to upgradient location.
* Monitoring wells near former cold dump.

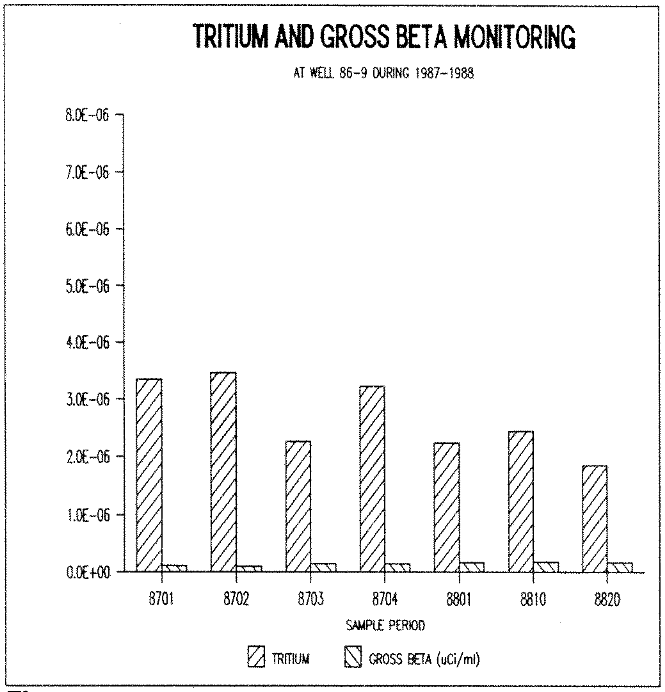


Figure 3-9
Tritium and gross beta monitoring results from well WNW86-9 in the High-Level Radioactive Waste Management Unit.

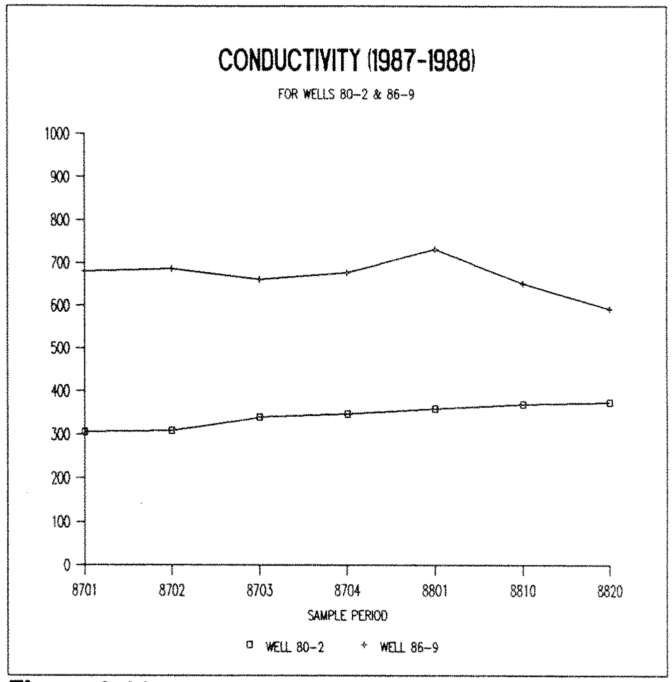


Figure 3-11
Conductivity data (μmhos/cm @ 25 °C) from wells WNW80-2 and WNW86-9 in the High-Level Radioactive Waste groundwater monitoring unit.

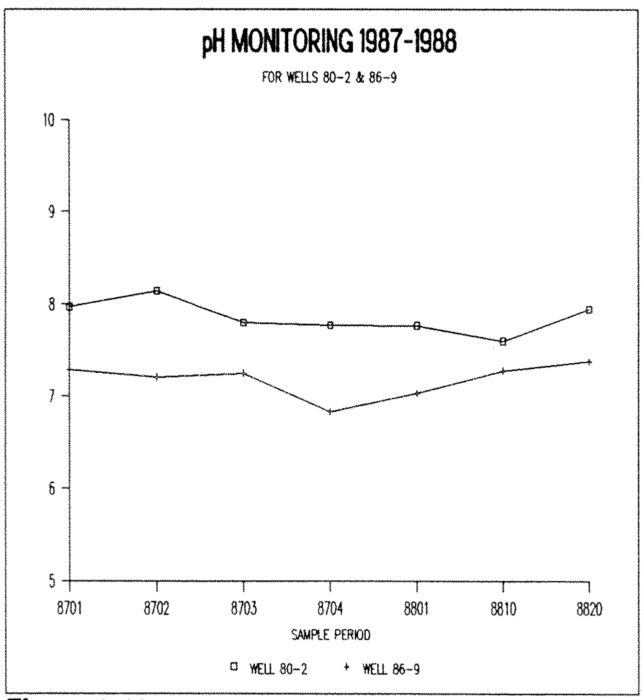


Figure 3-10
pH data from wells WNW80-2 and WNW86-9 in the High-Level Radioactive Waste groundwater monitoring Unit.

3.3.5 Significance of Waste Management Unit Monitoring

The above discussions indicate that real differences do exist between upgradient and downgradient groundwater monitoring locations within waste management units monitored at the Project.

Groundwater quality in the vicinity of the lagoon system has apparently improved since Lagoon 1 was taken out of service in 1984. The improvement is indicated by the 7-year trend plot for tritium at location WNSP008 (Figure 3-5). Whether this decrease in tritium concentration was caused by the removal from service of Lagoon 1 or by processing water with lower tritium activity in the current lagoon system is not clear. Additional monitoring in this unit may be required to fully assess the movement of contaminated groundwater in the immediate vicinity of former Lagoon 1, where gross beta activities are at a level of 1.1 E-5 to 3.1 E-5 μCi/mL.

Table 3-4

Statistical Summary of Groundwater Monitoring from NRC-Licensed Disposal Area: Differences Observed at Downgradient Wells Compared to Upradient Well WNW83-1D

Parameter	WNW86-10	WNW86-11	WNW82-1D
pH	same	same	dry
Conductivity	inc	inc	dry
Nitrate-N	no	no	dry
TOC	no	no	dry
Barium	no	no	dry
Manganese	no	no	dry
Sodium	inc	inc	dry
Tritium	no	no	dry
Gross beta	no	no	dry
Gross alpha	no	no	dry
Cesium-137	no	no	dry
Cobalt-60	no	no	dry

Notes: For pH, "same" indicates no change, "decr" indicates decrease.
For all parameters, "no" indicates lack of significant increase, and "inc" indicates increase as compared to upgradient location.

In the high-level radioactive waste tank complex area, differences between upgradient and downgradient monitoring locations appear consistent with past analyses. The differences observed do not appear to be widening. Additionally, the changes noted for pH are opposite those expected, if alkaline wastes were entering the groundwater from this location. Groundwater monitoring in the vicinity of the NRC-Licensed Disposal Area revealed no significant increases in monitored radiological parameters at downgradient locations. The differences noted for conductivity may be a function of the differing well depths between upgradient and downgradient locations.

The waste management unit groundwater monitoring program at WVDP is currently under review and will probably be expanded to incorporate changes in the regulatory environment and in suggested methods of data analysis [USEPA 1989]. It is anticipated that new monitoring locations will be selected and instrumented, and that areas which now indicate contamination will be analyzed using methods designed to evaluate changes at these locations in addition to comparisons with upgradient locations. These additions will provide better resolution between current Project activities and past impacts to the local environment. The added information will allow for increased understanding of the processes occurring in each of the monitored waste management units.

3.3.6 Other Supporting Wells Monitored On Site

"Supporting" wells monitored on site include those wells which are not part of the waste management unit monitoring program. These wells are monitored on a semiannual cycle. The data are shown in Table E-1 and are consistent with past data. Of interest is the repeated detection of elevated levels of tritium at well location WNW82-4A1 located to the north of the disposal area. However, adjacent wells WNW82-4A2 and 4A3, which are at approximately the same depth, exhibit significantly lower tritium concentrations than well WNW82-4A1, as they have in past years. This provides reassurance that there is no general movement of tritium in the groundwater in this area.

3.3.7 Groundwater Monitoring at the Below-Grade Fuel Storage Area

Table E-2 presents results for groundwater monitoring in the vicinity of the below-ground gasoline and diesel fuel storage area. Analyses for selected volatile organic constituents were consistent with past years and do not indicate any groundwater contamination. Monitoring of other selected parameters at this location are also consistent with past data and are not indicative of contamination.

3.3.8 Off-site Groundwater Monitoring

The results are presented in Table C-1.6 from samples collected from nearby off-site private residential wells used for drinking water by site neighbors. Tritium, considered the best indicator of contamination, was not detected at any of the off-site well locations at the detection limit of 1 E-7 μCi/mL. No other constituents that would indicate contamination by Project activities were detected. The DOE derived concentration guide (DCG) for tritium in drinking water is 2 E-3 μCi/mL. The off-site water supply results are less than 0.005% of the recommended limit.

4.0 RADIOLOGICAL DOSE ASSESSMENT

4.0 INTRODUCTION

This chapter reports the methodology used to estimate the potential radiation dose to members of the public from airborne and liquid effluents released by the West Valley Demonstration Project (WVDP) during 1988. The resulting dose estimates are based on the effluent monitoring data and various air and biological samples collected throughout 1988. These estimates are then compared to the environmental standards established by the Department of Energy (DOE) and the Environmental Protection Agency (EPA) to determine whether members of the public received significant radiation doses as a result of WVDP activities. The radiation doses reported for 1988 are compared to the doses reported in previous years.

Computer models were used to calculate the dispersion of radioactive effluents in the environment and the potential pathways of exposure to the public. Radionuclide concentrations in air and biological samples collected near the site were compared to background concentrations. For concentrations in excess of background, an estimate was made of the maximum radiation dose that would be incurred by a nearby resident from breathing or ingesting that radionuclide.

The following sections define some key terms and units used to measure radiation and radiation dose. The magnitude and potential health effects of the public's exposure to radiation from natural and man-made sources are also discussed. The radiation dose to members of the public contributed by WVDP activities can thus be placed in the proper perspective.

4.1.1 Sources of Exposure to Radiation

As defined here, radiation is the emission of energy in the form of particles (alpha and beta rays, neutrons) or electromagnetic waves (gamma rays) from the nuclei of atoms. X-rays are also a form of electromagnetic radiation emitted when electrons lose energy rapidly. The emission of radiation can occur as a result of nuclear fission (all forms of radiation). It can be induced by accelerating electrons across an electric field and into a target (x-rays). Only the random emission as the result of spontaneous nuclear decay (alpha, beta, gamma and x-rays) is of concern in WVDP effluents.

Radionuclides are defined as the unstable isotopes of an element, such as carbon, iodine, or uranium, which decay by the emission of radiation. The resulting nuclide may be either stable (non-radioactive) or radioactive. The amount of a radioactive material is measured by its activity, expressed in units of curies (Ci) or becquerels (Bq), and represents the rate at which the radioactive atoms in the material are decaying. One becquerel of activity corresponds to one decay per second; one curie equals 37 billion becquerels. Over a fixed period, a constant fraction of the radioactive atoms in a material will decay. Each radioactive isotope has a unique half life which represents the time in which half of the atoms of that isotope have decayed. Strontium-90 and cesium-137 have half-lives of about 30 years, while plutonium-239 has a 24,000 year half-life.

Most of the radiation dose affecting the public occurs as part of the earth's natural radiation background. All members of the public are constantly being bombarded by cosmic and terrestrial radiation. Some naturally occurring radionuclides are incorporated in foods, body tissues, organs and bones. Naturally occurring radon gas and its radioactive daughters concentrate in closed areas such as basements and poorly ventilated buildings. The concentration in air depends on such factors as geographic location and building ventilation. The annual radiation dose to an average person living in the United States contributed by naturally occurring radiation is shown in Figure 4-1.

Man-made sources of radiation may also contribute to the radiation dose of individual members of the public. Such sources include diagnostic and therapeutic x-rays, nuclear medicine, consumer products (such as smoke detectors and cigarettes), fallout from atmospheric nuclear weapons tests, and effluents from the nuclear fuel

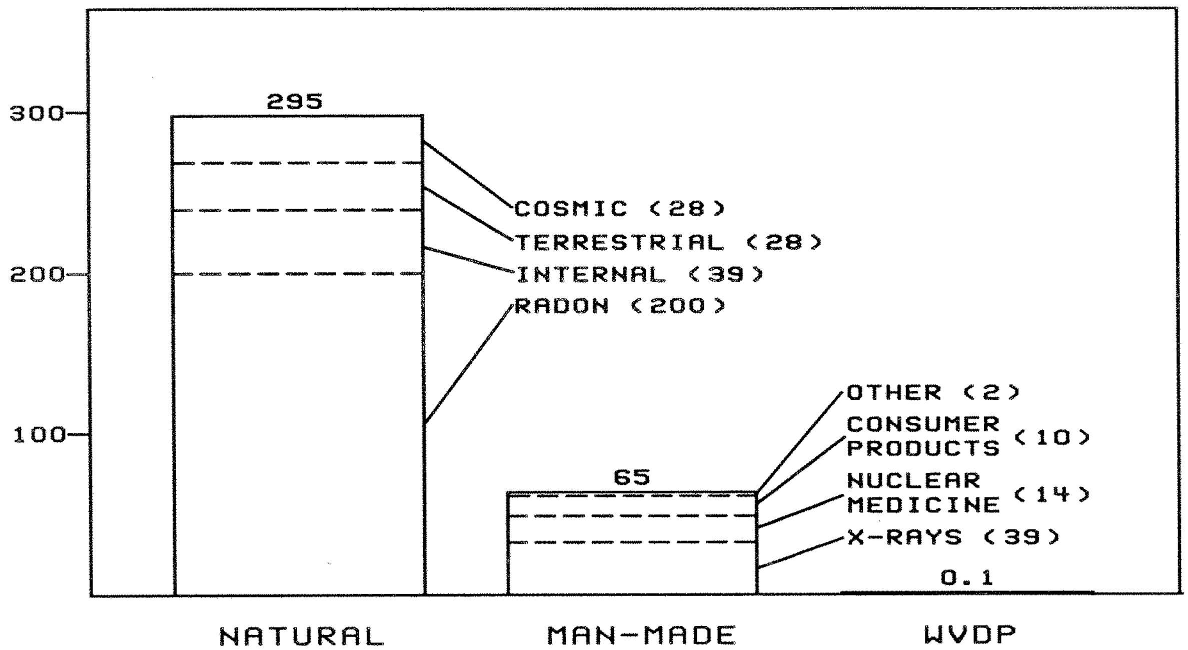


Figure 4-1
Comparison of annual radiation doses (mrem) to an average member of the U.S. population [NCRP 1987] with the maximum dose to an off-site resident from 1988 WVDP ef-

cycle (of which the WVDP is a part). The extent to which any member of the public is exposed to these sources is variable and depends on such factors as health, personal habits, and geographic location. The annual radiation dose to an average person living in the U.S. contributed by man-made radiation is shown in Figure 4-1.

4.1.2 Potential Health Effects from Exposure to Radiation

The health effects of radiation depend on the amount and type of radiation energy deposited in living cells. The radiation may originate from sources outside the body or from radionuclides inside the body (resulting from inhalation or ingestion of contaminated air, water, or food). External or internal irradiation of the body by alpha rays or beta, gamma, and x-rays produce significantly different biological effects for the same amount of energy absorbed in tissue. The concept of dose equivalent (DE) was developed by the radiation protection community to allow direct comparison or addition of doses from different types of radiation. The SI unit of dose equivalent is the sievert (Sv), which is equal to 100 rem. One mSv or one mrem is equal to one thousandth of one Sv or rem, respectively. The National Council on Radiation Protection and Measurements (NCRP) Report 93 [NCRP 1987] estimates that the average annual DE received by a person living in the U.S. is about 360 mrem (3.6 mSv) from natural and man-made sources of radiation (Figure 4-1). This number is based on the collective DE, defined as the total DE received by a population (expressed in units of person-Sv or person-rem). The average individual DE is obtained by dividing the collective DE by the population number.

Radionuclides entering the body through inhalation of contaminated air or ingestion of contaminated food or water are usually distributed unevenly in different tissues and organs in the body. Isotopes of iodine concentrate in the thyroid gland. Strontium, plutonium and americium isotopes concentrate in the skeleton. Uranium and plutonium isotopes, when inhaled, stay in the lungs for a long time. On the other hand cesium isotopes and tritium, an isotope of hydrogen usually tied up in a water molecule, will be distributed uniformly throughout the body.

Publication 2 of the International Commission on Radiological Protection (ICRP) [ICRP 1959] considered, for each radionuclide, the effects of uniform irradiation of the whole body and of the organ receiving the highest DE (the "critical organ") for either ingestion or inhalation of radionuclides. Limits were placed on the permissible dose to the whole body or any individual organ and the allowable radionuclide concentrations in air and water.

Current ICRP recommendations issued in Publications 26 and 30 [ICRP 1977, 1979] employ a risk-based methodology rather than the critical organ concept. The risk factor for fatal cancer induction in certain organs (per unit DE) is divided by the risk factor for a cancer fatality when the whole body is irradiated uniformly at that dose. This weighting factor represents the relative sensitivity of a particular organ to develop a fatal cancer. The DE to each organ is multiplied by the respective weighting factor. These weighted DEs are then summed to obtain the effective DE. The latter represents the increased risk of fatal cancer induction (based on a probability of 165 per million person-rem) over a 50 year period following the exposure to radiation.

The Committee on Biological Effects of Ionizing Radiations (BEIR) estimated that the lifetime risk of a cancer fatality from a single exposure to 10 rem (0.1 Sv) of radiation ranges from 0.5 to 1.4 percent of the background cancer mortality risk. In the U.S. the cancer mortality rate from all causes is currently about one in eight. The BEIR Committee stressed that the health effects at very low levels of radiation exposure are not clear, and any extrapolation of risk estimates at these levels is subject to great uncertainty [BEIR 1980]. As will be shown in the following sections, the estimated maximum DE received by a member of the public from WVDP activities during 1988 is many orders of magnitude lower than the exposures considered in the BEIR report.

4.2 ESTIMATED RADIATION DOSE FROM AIRBORNE EFFLUENTS

As reported in Section 2.1.1, five stacks and vents were monitored for radioactive air emissions during 1988. The activity that was released to the atmosphere from these stacks and vents is listed in Tables C-2.1.1 through C-2.1.11 in Appendix C. In addition, the laundry and LLWT vents were monitored for gross alpha and beta emissions. Except for the main plant stack, which vents to the atmosphere at a height of 60 m, (197 ft.) all releases were at ground level 10 m (33 ft).

Two methodologies were employed to calculate the radiation dose to the public from airborne effluents. The first method considers the specific terrain around the site and the effect of that terrain on wind flow. The second method does not consider terrain and uses the older dose models.

The hills and valleys in the vicinity of the site frequently channel the winds. To realistically account for terrain effects on wind flow, the Dames & Moore computer code WNDSRF3 was used to develop a two-dimensional wind field. The wind field data were then used as input to EPM3, a variable-trajectory Gaussian puff dispersion computer code, to calculate the relative radioactive effluent concentrations in areas within an 80-km (50 mile) radius of the site. Relative concentrations were calculated for elevated (60 m) and ground level (10 m) releases. These relative concentrations (also known as X/Qs) were used as input to AIRDOS-EPA, a version of AIRDOS that uses the current ICRP risk-based dose models. AIRDOS [Moore et al. 1979] is a pathway analysis computer code for airborne radioactive effluents. It is used to estimate the radiation dose from direct exposure to radioactivity in the air and on the ground. It also computes the dose from inhalation of contaminated air and ingestion of contaminated water and foods produced near the site. A detailed discussion of the computer codes WNDSRF3, EPM3 and AIRDOS-EPA is given in "Radiological Parameters for Assessment of West Valley Demonstration Project Activities" [Yuan and Dooley 1987].

The Clean Air Act Code (CAAC) was used to comply with the requirements of EPA regulations contained in 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H" [USEPA 1983a]. This version of the AIRDOS pathway analysis computer code uses simplified straight-line Gaussian methodology, which does not account for terrain effects on wind flow, and implements the dose models of ICRP Publication 2. The NESHAP regulations are currently undergoing revisions which, if adopted, will implement the current ICRP dose models. A detailed discussion of the CAAC is given in "WVDP Radioactive Air Emissions Permit Application - General Information" [WVDP 1987].

Both methodologies were used to estimate the maximum potential DE to an off-site resident, the maximum organ DE, and the collective DE to the population within 80 km (50 miles) of the site. In the following sections, the doses calculated using AIRDOS-EPA will be presented first, followed by the dose computed using the CAAC (in square brackets). They are then compared to the EPA regulatory standards contained in 40 CFR 61. Table 4-1 includes a summary of the estimated radiation doses to the public from effluents released to the atmosphere.

4.2.1 Maximum Dose to an Off-Site Resident

Based on the airborne radioactivity released from the site during 1988, a person living in the vicinity of the WVDP was estimated to receive an effective DE of 0.00033 mrem (0.0000033 mSv) [0.00035 mrem (0.0000035 mSv) whole body DE]. This maximally exposed individual was assumed to reside continuously about 2.1 km WSW [3.4 km SE] from the site, eating locally produced foods at the maximum consumption rates for an adult.

The NESHAP limit on the whole body (or effective) DE to the maximally exposed off-site resident is 25 mrem (0.25 mSv). The doses reported above are well below this limit (0.0013% [0.0014%]) and are much lower than the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

The potential dose from airborne effluents incurred by the maximally exposed off-site resident was

Table 4-1. Summary of Calculated Radiation Doses from Effluents Released by the WVDP during 1988

Type of Release	Maximum Off-Site Resident Dose (mrem) Effective	Maximum Off-Site Resident Dose (mrem) Maximum Organ	Collective Dose(5) (person-rem)
Airborne, Elevated (60 m)(1)	0.00032 [0.000048]*	0.0032 Thyroid [0.0022 Thyroid]	0.0028 [0.0074]
Airborne, Ground level (10 m)(2)	0.000083 [0.00031]	0.0012 Thyroid [0.0035 Bone surfaces]	0.00016 [0.042]
Airborne, Combined(3)	0.00033 [0.00035]	0.0033 Thyroid [0.0039 Bone surfaces]	0.0030 [0.05]
Liquid(4)	0.1	Not Applicable	0.028
All	0.1	Not Applicable	0.031

* Numbers in brackets calculated with Clean Air Act Code version of AIRDOS.
(1) Maximally exposed resident lives 2.1 km WSW [3.4 km SE] from WVDP.
(2) Maximally exposed resident lives 1.4 km NW [1.9 km NNW] from WVDP.
(3) Same as (1). Note that contributions from ground-level releases to maximum resident doses are not fully additive.
(4) Calculated using LADTAP II.
(5) Estimated population of 1.7 million living within 80 km of site.

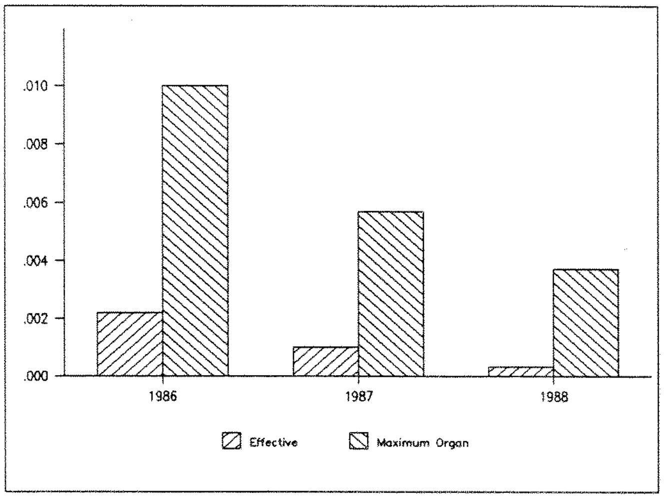


Figure 4-2
Maximum dose equivalent (mrem) to an individual residing near the WVDP from airborne effluents (calculated using AIRDOS-EPA).

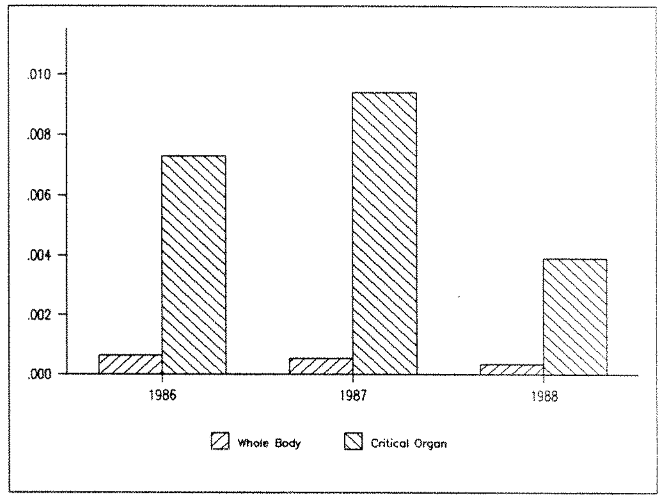


Figure 4-3
Maximum dose equivalent (mrem) to an individual residing near the WVDP from airborne effluents (calculated using the Clean Air Act Code).

67% lower [35% lower] in 1988 when compared to the previous year's estimate. Dose estimates from the past three years are presented for comparison in Figures 4-2 and 4-3.

4.2.2 Maximum Organ Dose

As a result of radioactivity in airborne effluents released from the site during 1988, the maximally exposed off-site individual incurred an estimated DE of 0.0033 mrem (0.000033 mSv) [0.0039 mrem (0.000039 mSv)] to the thyroid [bone surfaces], the organ receiving the highest dose.

The NESHAP limit on the DE to any organ of the body is 75 mrem (0.75 mSv). The doses reported above are well below this limit (0.0044% [0.0051%]).

The potential maximum organ dose from airborne effluents was 42% lower [59% lower] in 1988 when compared to the previous year's estimate. Dose estimates from the past three years are presented for comparison in Figures 4-2 and 4-3.

4.2.3 Collective Dose to the Population

As a result of airborne radioactivity released from the WVDP during 1988, the population living within 80 km (50 miles) from the site received an estimated collective effective DE of 0.0030 person-rem (0.000029 person-Sv) [collective whole body DE of 0.05 person-rem (0.0005 person-Sv)]. This estimate is based on a population of 1.7 million within this radius. The resulting average effective DE per individual is 0.0000018 mrem (0.000000018 mSv) [0.00003 mrem (0.0000003 mSv) average whole body DE].

There are no regulations limiting collective doses to the population. However, the calculated average individual dose is insignificant when compared to the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.
The collective dose from airborne effluents was 68% lower [138% higher] in 1988 when compared to the previous year's estimate. Dose estimates from the past three years are presented for comparison in Figures 4-4 and 4-5.

4.3 ESTIMATED RADIATION DOSE FROM LIQUID EFFLUENTS

As reported in Section 2.1.2, five batch releases of liquid radioactive effluents were monitored during 1988. The radioactivity that was discharged in these effluents is listed in Table C-1.1.1.

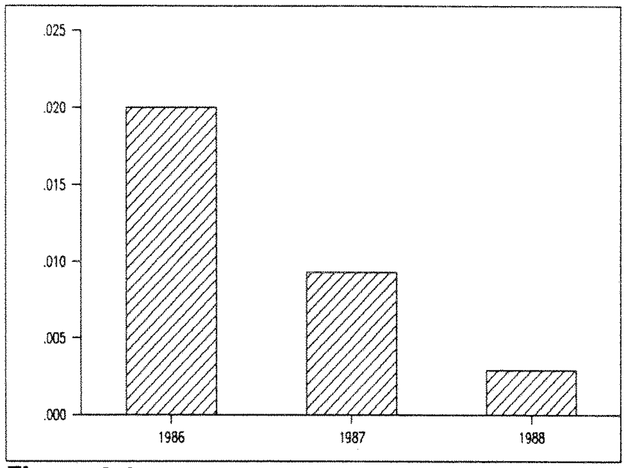


Figure 4-4
Collective effective dose equivalent (person-rem) to the population within 80 km of the WVDP from airborne effluents (calculated using AIRDOS-EPA).

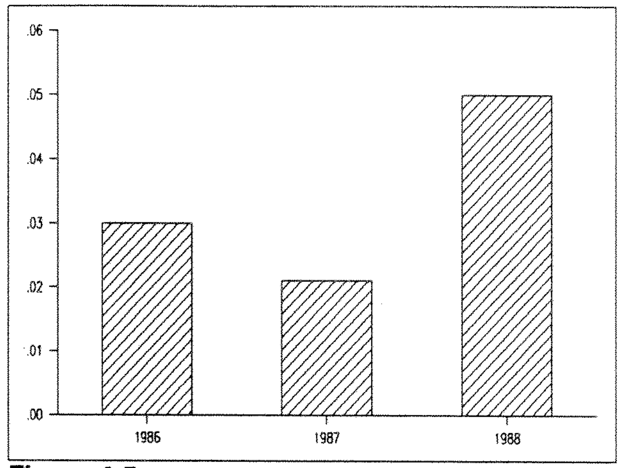


Figure 4-5
Collective whole-body dose equivalent (person-rem) to the population within 80 km of the WVDP from airborne effluents (calculated using the Clean Air Act Code).

The computer code LADTAP II [Simpson and McGill 1980] was used to calculate the dose to the maximally exposed off-site individual and the collective dose to the population from routine releases and dispersion of these effluents. Since the effluents eventually reach Cattaraugus Creek, which is not used as a source of drinking water, the primary exposure pathway calculated by the code is from the consumption of 21 kg (46 lbs.) of fish caught in the creek. A detailed description of LADTAP II is given in Yuan and Dooley, 1987.

Currently there are no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents except as applied in the 40 CFR 141 and 40 CFR 143 Drinking Water Guidelines [USEPA 1984b,c]. The potable water wells sampled for radionuclides are located upgradient of the WVDP and are not considered a realistic pathway in the dose assessment. Since Cattaraugus Creek is not designated as a drinking water supply, the radiation dose estimated using LADTAP II was compared with the limits stated in DOE Order 5480.1 [USDOE 1981].

4.3.1 Maximum Dose to an Off-Site Individual

Based on the radioactivity in liquid effluents released from the WVDP during 1988, an off-site individual was estimated to receive a maximum effective DE of 0.1 mrem (0.001 mSv). This dose is 0.1% of the 100-mrem (1-mSv) limit in DOE Order 5480.1 and is much lower than the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

The potential dose from liquid effluents incurred by the maximally exposed off-site individual was 60% lower in 1988 when compared to the previous year's estimate. Dose estimates from the past three years are presented for comparison in Figure 4-6.

No maximum organ dose was computed since LADTAP II employs the risk-based methodology currently recommended by the ICRP rather than the critical organ methodology of the older ICRP guidance.

4.3.2 Collective Dose to the Population

As a result of radioactivity released in liquid effluents from the WVDP during 1988, the population living within 80 km from the site received a collective effective DE of 0.028 person-rem (0.00028 person-Sv). This estimate is based on a population of 1.7 million living within this radius. The resulting average effective DE per individual is 0.000017 mrem (0.00000017 mSv). This dose is in-

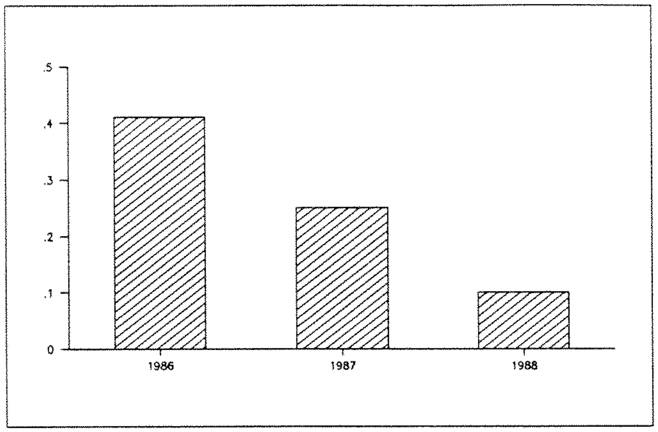


Figure 4-6
Maximum effective dose equivalent (mrem) to an individual residing near the WVDP from liquid effluents (calculated using LADTAP II).

significant when compared to the 300 mrem (3 mSv) that an average person receives in one year from natural background radiation.

The collective dose from liquid effluents was 40% lower in 1988 when compared to the previous year's estimate. Dose estimates from the past three years are presented for comparison in Figure 4-7.

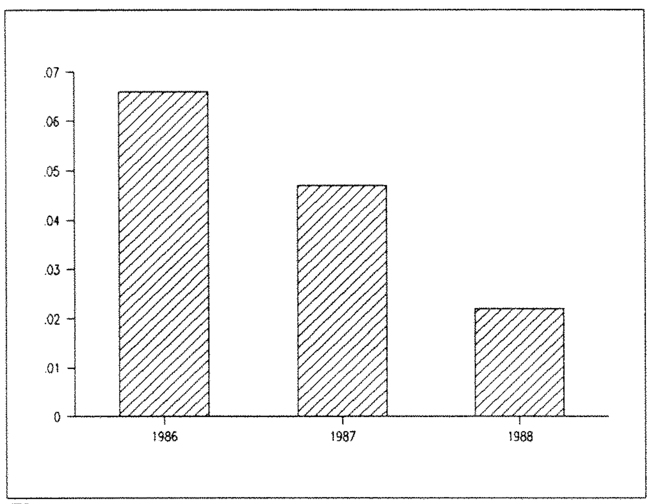


Figure 4-7
Collective dose equivalent (person-rem) to the population within 80 km of the WVDP from liquid effluents (calculated using LADTAP II).

4.4 ESTIMATED DOSE FROM ALL PATHWAYS

The potential dose to the public from both airborne and liquid effluents released from the WVDP during 1988 is simply the sum of the individual dose contributions. The potential effective DE from all pathways to the maximally exposed individual was 0.1 mrem (0.001 mSv). The total collective DE to the population within 80 km (50 miles) of the site was 0.031 person-rem (0.00031 person-Sv), with an average effective DE of 0.000018 mrem (0.00000018 mSv) per individual.

The maximum dose to an individual was 0.1% of the 100 mrem (1 mSv) annual limit in DOE Order 5480.1.

The 1988 estimated total individual and collective effective DEs from all pathways were lower than 1987 estimates by 60% and 45%, respectively. Figure 4-8 shows the trend in total collective DE to the surrounding population. The calculated DE to the maximally exposed individual from liquid effluents was much greater relative to the contribution from airborne effluents. Thus, Figure 4-6 also represents the total estimated maximum DE during the past three years.

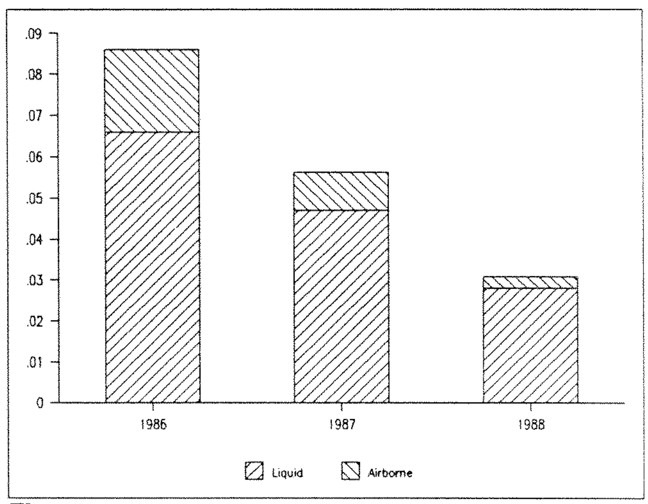


Figure 4-8
Total collective dose equivalent (person-rem) to the population within 80 km of the WVDP.

4.5 ESTIMATED RADIATION DOSE FROM LOCAL FOOD CONSUMPTION

In addition to dose estimates based on dispersion modeling, the maximum DE to a nearby resident was estimated based on consumption of locally produced food. Doses estimated using the computer models already incorporate the food pathway. Therefore, the following doses should not be added to doses reported in previous sections, but should serve as an additional means to measure the impact of WVDP operations.

Near-site and control samples of fish, milk, beef, venison, fruit, vegetables and cereal were collected. The samples were analyzed for various radionuclides, including tritium, potassium-40, cobalt-60, strontium-90, iodine-129, cesium-134 and cesium-137, as described in Section 2.1.3. The measured radionuclide concentrations reported in Tables C-3.1 through C-3.4 are the basis for these dose estimates.

With the exception of milk samples, all radionuclide concentrations are reported in terms of the dry sample weight. Prior to any dose calculations, the concentration per wet weight was reconstituted by factoring in the moisture content of the samples.

When statistically significant differences were found between near-site and background sample concentrations, the excess near-site sample concentration was used as a basis for the dose estimate. Most of the measured radionuclides were found to be under the minimum detectable concentration (MDC). When this was the case for both near-site and control samples, the concentrations in both were assumed to be at background levels.

The DE to a nearby resident was estimated for the consumption of foods with radionuclide concentrations found above background. The potential dose was calculated by multiplying the excess concentration by the maximum adult annual consumption rate for each food and the ingestion unit dose factor for the measured radionuclide. The consumption rates are based on site-specific data and recommendations in the NRC Regulatory Guide 1.109 for terrestrial food-chain dose assessments [USNRC 1977]. The unit dose factors for ingested radionuclides are based on current ICRP methodology [Yuan and Dooley 1987].

The results of the dose estimates for each food type are reported in the following sections. A summary of the estimated maximum DE to a nearby resident from consumption of locally produced food is presented in Table 4-2. The three-year trend in total DE from consumption of all the sampled food products is plotted in Figure 4-9. All of the calculated doses are well below both the EPA and DOE limits discussed in the previous sections.

4.5.1 Milk

Milk samples were collected from various nearby dairy farms throughout 1988. Control samples were collected from farms 25-30 km (15-20 miles) to the south and north of the WVDP. As reported in Table C-3.1, milk samples were measured for tritium, strontium-90, iodine-129, cesium-134, and cesium-137. Only strontium-90 was found above MDC levels. To obtain a conservative estimate, the average background concentration was subtracted from the near-site sample with the highest reported concentration. Based on an annual consumption rate of 310 liters, (327 quarts) the maximum effective DE from drinking this milk was estimated to be 0.18 mrem (0.0018 mSv). The highest organ DE (to bone surfaces) was estimated to be 1.9 mrem (0.019 mSv). Estimated doses resulting from the consumption of milk for the past three years are shown in Figure 4-10.

4.5.2 Beef

Near-site and control samples of locally raised beef were collected during middle and late 1988. As reported in Table C-3.2, these samples were measured for strontium-90, cesium-134 and cesium-137 concentrations. Only strontium-90 was detected above MDC levels, with the highest excess concentration reported in beef sampled during late 1988. Based on an annual consumption rate of 110 kg (242 pounds), the maximum effective DE from eating this meat was estimated to be 0.063 mrem (0.00063 mSv). The highest organ DE (to bone surfaces) was estimated to be 0.68 mrem (0.0068 mSv). Estimated doses resulting

TABLE 4-2. Summary of Maximum Radiation Doses to an Individual from Consumption of Food Produced in the Vicinity of the WVDP

Food	Sample Location	Maximum Annual Consumption[1]	Dose Equivalent (mrem) Effective	Dose Equivalent (mrem) Maximum Organ[2]
Milk	Dairy Farm 3.8 km NNW of WVDP	310 liters	0.18	1.9
Beef	Farm 3.5 km N of WVDP	110 kg	0.063	0.68
Venison	Within 2 km of WVDP	45 kg	0.0053	0.057
Apples	Collected 1 km S of WVDP	52 kg	0.08	0.86
Fish	Cattaraugus Creek downstream of Springville Dam	21 kg	0.041	0.44
TOTAL			0.37	3.9

(1) From NRC Regulatory Guide 1.109 (except venison)
(2) Bone surfaces

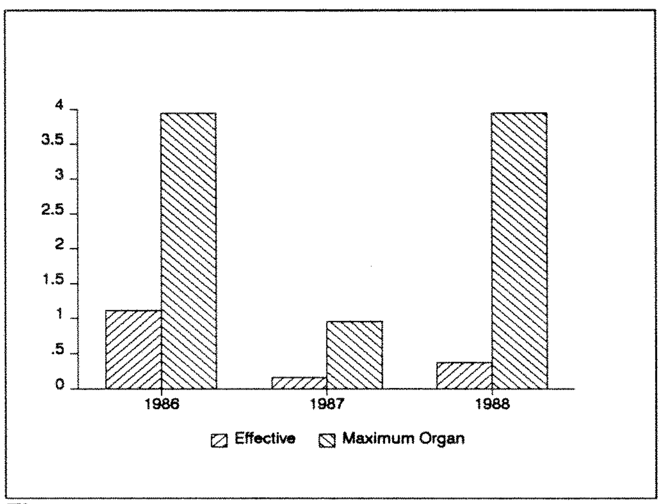


Figure 4-9
Maximum dose equivalent (mrem) to an individual from foods produced near the WVDP.

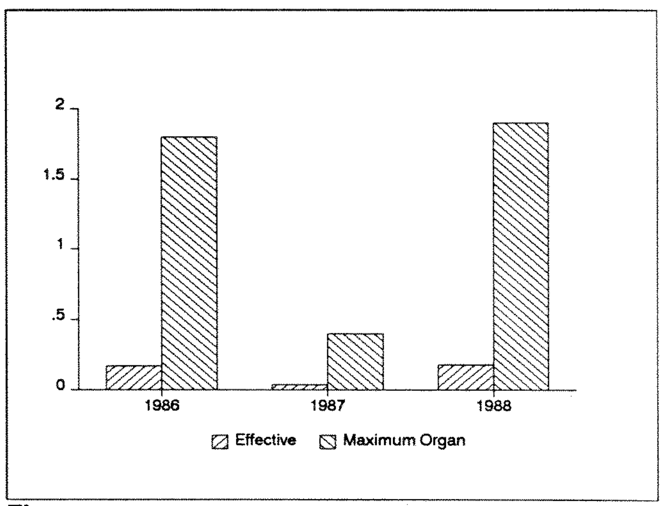


Figure 4-10
Maximum dose equivalent (mrem) to an individual from consumption of milk produced near the WVDP.

from the consumption of beef for the past three years are shown in Figure 4-11.

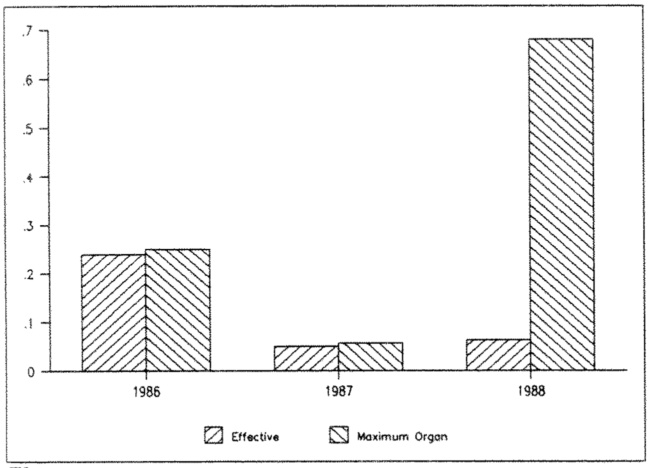


Figure 4-11
Maximum dose equivalent (mrem) to an individual from consumption of beef from cattle raised near the WVDP.

4.5.3 Venison (Deer)

Meat samples from three near-site and three control deer were collected in the last months of 1988. As reported in Table C-3.2, these samples were measured for strontium-90, cesium-134 and cesium-137 concentrations. Strontium-90 and cesium-137 were detected above MDC levels; however, average cesium-137 concentrations in background specimens were slightly higher than average concentrations in near-site specimens. Based on an annual consumption rate of 45 kg (100 pounds), the maximum effective DE from eating this meat was estimated to be 0.0053 mrem (0.000053 mSv). The highest organ DE (to bone surfaces) was estimated to be 0.057 mrem (0.00057 mSv). Estimated doses resulting from the consumption of venison for the past three years are shown in Figure 4-12.

4.5.4 Produce (Apples, Tomatoes and Corn)

Near-site and control samples of apples, tomatoes, and corn were collected in the third quarter of 1988. Samples of hay were also collected, but were not considered in the dose assessment because hay contributes only indirectly to the human

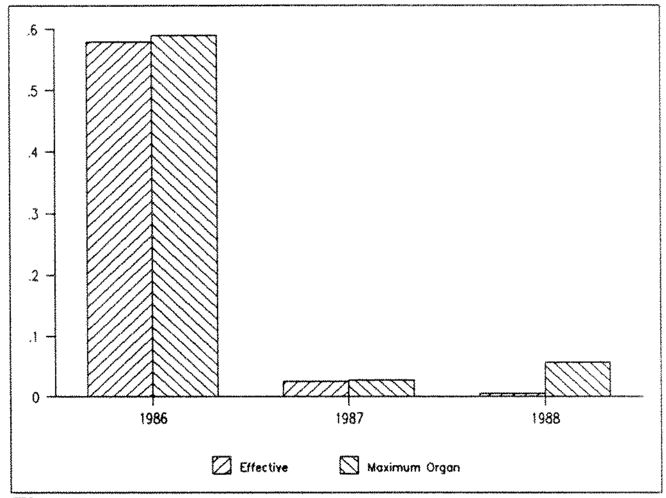


Figure 4-12
Maximum dose equivalent (mrem) to an individual from consumption of venison from deer taken near the WVDP.

food chain. As reported in Table C-3.3, these samples were measured for tritium, strontium-90, potassium-40, cobalt-60 and cesium-137 concentrations. Samples are analyzed for potassium-40, since it provides a built-in calibration spike from a natural isotope of potassium not released in WVDP effluents. Of all the samples and radionuclides analyzed, only strontium-90 in near-site apples was found at levels above the MDC and at a concentration higher than control specimens. In all other cases either the radionuclides were below MDC levels, or no statistically significant differences were found between near-site and control specimens. Based on an annual produce consumption rate of 52 kg (114 pounds), the maximum effective DE from eating this quantity of apples was estimated to be 0.08 mrem (0.0008 mSv). The highest organ DE (to bone surfaces) was estimated to be 0.86 mrem (0.0086 mSv). Estimated doses from ingestion of local produce from previous years are not available for comparison.

4.5.5 Fish

Fish were caught in the second and third quarters of 1988 in Cattaraugus Creek upstream (control samples) and downstream (above and below the Springville dam) from the site. As reported in Table C-3.4, samples of fish flesh were measured for strontium-90, cesium-134 and cesium-137 concentrations. Only strontium-90 was detected above MDC levels, with the highest excess concentration reported in fish caught during the second quarter downstream of the Springville dam. Based on an annual consumption rate of 21 kg (46 lbs.), the maximum effective DE from eating this fish was estimated to be 0.041 mrem (0.00041 mSv). This compares well with the 0.1 mrem (0.001) estimated using the LADTAP II liquid effluent dispersion code. The highest organ DE (to bone surfaces) was estimated to be 0.44 mrem (0.0044 mSv). Estimated doses resulting from the consumption of fish for the past three years are shown in Figure 4-13.

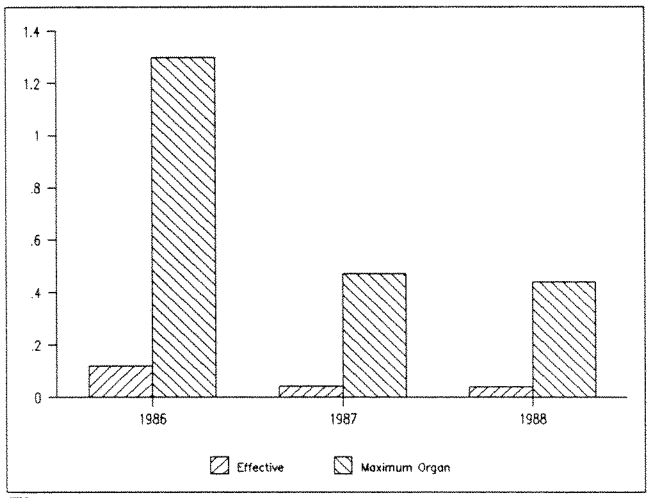


Figure 4-13
Maximum dose equivalent (mrem) to an individual from consumption of fish caught in Cattaraugus Creek downstream of the WVDP.

4.6 STATISTICAL ANALYSIS OF AIR SAMPLER DATA

Environmental air samplers are located in the vicinity of the site and at background locations. These samplers measure gross alpha, gross beta, strontium-90 and cesium-137 concentrations in air as reported in Tables C-2.2.1 through C-2.2.9 (Appendix C). To see if any measurable increases in airborne radionuclide concentrations could be detected in the air sampler data, a simple one-way analysis of variance (ANOVA) statistical test was performed. At the 99 percent confidence level, no statistically significant differences were found in any of the sampler data, indicating that these samplers are measuring background concentration levels. These findings agree with the conclusions drawn from the dispersion models. Average concentrations of radionuclides contributed by WVDP airborne effluents would be five to six orders of magnitude below the measured background levels at the sampler locations. Such small increments are impossible to detect within the variability of background radionuclide concentrations in air.

4.7 CONCLUSIONS

In summary, the dose assessment shows that during 1988 the WVDP was in compliance with all applicable emission standards and dose limits. The doses to the public estimated from effluent dispersion models and radionuclide concentrations in food samples were well below these limits, resulting in an insignificant impact on the public's health.

5.0 STANDARDS AND QUALITY ASSURANCE

5.1 ENVIRONMENTAL STANDARDS AND REGULATIONS

The following Department of Energy Orders, environmental standards and laws are applicable to the WVDP:

- DOE Order 5400.1, "General Environmental Protection Program", November, 1988.
- DOE Order 5480.1, "Requirements for Radiation Protection," August 1981.
- DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 1981.
- Clean Air Act, 42 USC 1857 *et seq.*, as amended.
- Federal Water Pollution Control Act (Clean Water Act), 33 USC 1251, as amended.
- Resource Conservation and Recovery Act, 42 USC 6905, as amended. (Including Hazardous and Solid Waste Amendments of 1984).
- Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 960. (Including Superfund Amendments and Reauthorization Act of 1986).
- Toxic Substances Control Act, 15 USC 2601, as amended.
- Environmental Conservation Law of New York State.

The standards and guides applicable to releases of radionuclides from the WVDP are those of DOE Order 5480.1 Chapter XI, dated August 13, 1981, entitled, "Requirements for Radiation Protection." Radiation protection standards and selected radioactivity limitations from Chapter XI, as amended by the Derived Concentration Guides, are listed in Appendix B.

These listed concentrations are guidelines provided by DOE to assure compliance with the performance standard of 100 mrem effective dose equivalent to the maximally exposed individual.

Ambient water quality standards contained in the SPDES permit issued for the facility are listed in Table C-5.2. Airborne discharges are also regulated by the EPA under the National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, 1984.

5.2 QUALITY ASSURANCE

Off-site laboratories performed the majority of the analyses requiring radiochemical separation or chemical pollutant analyses for the environmental samples collected during 1988. The documented quality assurance plan used by these laboratories includes periodic interlaboratory cross-checks, prepared standard and blank analyses, routine instrument calibration, and use of standardized procedures. Off-site laboratories analyze blind duplicates of approximately 10 percent of the samples analyzed on-site for the same parameters in addition to unknown cross-check samples provided through the WVDP Environmental Laboratory.

Physical surveys were made of the contract laboratory facilities and in the process of qualifying and adding off-site service contracts in conjunction with quality assurance reviews by Project personnel.

Sample collection, preparation, and most direct radiometric analyses were performed at the WVDP Environmental Laboratory for all media collected. For all continuous sampling equipment, measurement devices, and counting instruments, periodic calibration was maintained using standards traceable to the National Institute of Standards and Technology (formerly National Bureau of Standards). Specific calibration schedules and operational checks are required and were met in 1988 for critical instruments.

Sampling protocols based on the EPA requirements for nonradiological analyses were established specifically for groundwater collection. Other collections, such as surface water, sediments, and biological samples were performed using appropriate techniques to meet established laboratory procedures and surveillance program schedules. Sampling methods are periodically observed and evaluated in practice by senior laboratory personnel as well as outside agencies such as the NRC and the NYSDEC.

Formal cross-check programs between the WVDP Environmental Laboratory, the DOE Radiological and Environmental Science Laboratory at the Idaho National Engineering Laboratory (INEL), the EPA Environmental Monitoring Systems Laboratory in Las Vegas (EMSL), and the Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental sample types monitored in 1988. Comparative data from a variety of environmental materials analyzed at WVDP, off-site contract labs, and EML are summarized in Table D-1.1 Table D-1.2 compares the results of the program initiated in 1988 with EPA's EMSL environmental radioactivity measurement. Table D-1.3 gives the cross-check results from the INEL's gamma-in-water sample. New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH ELAP) certification samples are reported in Tables D-1.4 and D-1.5. The EPA cross-check programs for nonradiological water quality parameters also provided audit samples in 1988 (Table D-1.6). Data in Table D-1.7 are TLD monitoring point results from dosimeters co-located with the NRC.

The 214 blind quality assurance parameters and cross-checks measured and reported in 1988 showed an acceptable program, with one specific facet requiring improvement. Gamma spectroscopy sensitivity had been identified for improvement. After obtaining additional certified standards and preparing a more sensitive geometry for normal use, the accuracy of the gamma spectroscopy analyses was improved to one percent of the DOE DCG for cesium-137. This process was completed by April of 1988.

No isotopes counted and reported at the WVDP had been affected by the lower sensitivity, but the overall improvement in detection levels increased the precision on routine samples by a significant amount.

Of the 36 analyses reported in Table D-1.1 for the EML air, soil, vegetation, and water samples, one plutonium-239 analysis in soil performed by a contract laboratory fell outside the "passing" range and three other analyses were within the marginally acceptable area. These numbers represent 97 percent passing and 89 percent completely acceptable on these media. The overall test results, including all analyses, averaged a ratio of 1.04.

Results for the new program with EMSL are recorded in Table D-1.2. The initial gamma-in-water test, although below the normal instrument detection limits of the WVDP Environmental Laboratory geometry in use at the time, showed the results to be correct within the limits of uncertainty of our analysis. The precision was not adequate, however, to meet the rigorous criteria applied by the EPA's program in this instance. Once identified improvements were implemented before the second EPA gamma-in-water tests, the required precision was obtained for acceptable values. One sample for iodine-131 in milk and two samples for strontium-89/90 in milk analyzed off-site were unacceptable; the two unacceptable radium results were reported on preliminary data which were adjusted to what would have been acceptable values in the final contract laboratory report, received after the internal reporting deadline. The overall ratio is 1.02 for 53 EMSL sample results, with 79 percent of these results within the acceptable range. If the initial gamma scan and the preliminary radium results are not included, the result is an 89 percent passing rate.

The INEL sample, tallied in Table D-1.3, shows good agreement on those isotopes which are normally reported in the WVDP environmental surveillance program. The lack of precision in the remaining isotopes was corrected, as shown in subsequent cross-checks, by use of a new calibration source set.

The chemical analyses represented in Tables D-1.4, D-1.5, and D-1.6 were all satisfactory, but two. These were not due to incorrect analytical techniques, but resulted from failure to add in a dilution factor per the test instructions. The results overall were 98 percent acceptable, with a ratio of 1.02 on the January NYSDOH samples, 0.99 for the June

NYSDOH samples (excluding the two miscalculated outliers), and 1.02 for the EPA July samples.

TLDs co-located with NRC dosimeters at eight points around the WVDP perimeter and facility showed acceptable agreement for all four quarters compared (Table D-1.7). The comparison ratio is 1.11 for the two systems of TLDs in 1988. Project dosimetry is consistently placed at a height of 1 meter (3 ft.), but the NRC dosimeters are usually placed at 1.5 to 3 meters (5-10 ft.), which may partially account for the variances.

As indicated by the various audit and cross-check results, the WVDP Environmental Monitoring Program is functioning well, and the improvements in 1988 have been reflected in a very satisfactory cross-check record.

5.3 STATISTICAL REPORTING OF DATA

Except where noted, individual analytical results are reported with plus or minus (±) two standard deviations (2 σ) giving a value at the 95 percent confidence level. The arithmetic averages were calculated using actual results, including zero and negative values. In the final results, if the uncertainty (2 σ) was equal to or greater than the value, the measurement was considered to be below the Minimum Detectable Concentration (MDC) (see Section 5.4), and is reported as a less-than (<) value. These MDC values will vary among samples, especially in biological media where sample size cannot be easily standardized.

The total statistical uncertainty for radiological measurements, including systematic (processing and physical measurement) uncertainty plus the random radioactivity counting uncertainty, is reported as one value for the 1988 data. In most cases, systematic uncertainties (e.g., due to laboratory glassware or analytical balance variation) are a small percentage of the larger counting uncertainties at typical environmental levels of radioactivity. The notation normally used in reporting of raw laboratory data to convey the total uncertainty is in the form: (V.00 ± R.0 or T.0) E-00 where "V.00" is the analytical value to three significant figures, "R.0" is the random uncertainty to two significant figures, "T.0" is the total of random plus systematic uncertainties, and "E-00" is the exponent of 10 used to signify the magnitude of the parenthetical expression.

5.4 ANALYTICAL DETECTION LIMITS

For unique or individual samples analyzed on an infrequent basis, generic minimum detection limits for the entire analytical measurement protocol have not been developed, although a Lower Limit of Detection (LLD) based solely on the counting uncertainty is calculated for each sample. For routine measurements using standardized sample sizes, equipment, and preparation techniques, an average MDC has been calculated for WVDP environmental samples. These are listed in Table 5-1.

Specific sample media were analyzed for radionuclides from multiple split samples using routine procedures, normal laboratory techniques, and standard counting parameters. The counting statistics determined the estimated LLD above which there was 95 percent probability that radioactivity was present. This LLD is derived from the detection efficiency of the measuring instrument for the type of activity being measured, the level of normal background signal with no sample present (determined by counting a "background" sample of the same material) and the length of time the background and sample were counted. For radioactive decay, these factors can be used to accurately predict the lowest value that can be measured at a given confidence level.

A separate calculation for systematic uncertainty, including the variation between duplicate samples, labware differences, and physical measurements, was made and added to the statistical counting LLD to obtain the minimum analytical detection limit or MDC for the entire process. Volumetric measurement of sample flow rates, calibration standard uncertainties, and pipetting device accuracy were some of the factors included in this calculation. The overall result is the average MDC (at the 95 percent confidence level) for each type of sample treated in a uniform manner. For most sample analyses, there is little or no significant difference between the LLD and the MDC.

TABLE 5-1
MINIMUM DETECTABLE CONCENTRATIONS FOR ROUTINE SAMPLES

Measurement	Medium	Sample Size	MDC
gross alpha	water	1 L	8.1 E-10 μCi/mL
gross beta	water	1 L	7.7 E-10 μCi/mL
cesium-137	water	500 mL	1.0 E-08 μCi/mL
tritium	water	5 mL	1.0 E-07 μCi/mL
strontium-90	water	1 L	1.6 E-09 μCi/mL
gross alpha	air	400 m3	7.0 E-16 μCi/mL
gross beta	air	400 m3	7.0 E-15 μCi/mL
cesium-137	air	400 m3	1.4 E-14 μCi/mL
gross alpha	soil	100 mg	5.5 E-06 μCi/g
gross beta	soil	100 mg	5.3 E-06 μCi/g
cesium-137	soil	350 g	6.3 E-08 μCi/g

6.0 REFERENCES

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APPENDIX A
EFFLUENT, ON-SITE, AND OFF-SITE MONITORING PROGRAM

1988 EFFLUENT, ON-SITE, AND OFF-SITE MONITORING PROGRAM

The following schedule represents the WVDP routine Environmental Monitoring Program which was in place in 1988. This schedule meets or exceeds the minimum program needed to satisfy the requirements of DOE Order 5484.1, Chapter III. Specific methods and recommended monitoring program elements are referenced in DOE/EP-0096 (Effluent Monitoring) and DOE/EP-0023 (Environmental Surveillance), and are the bases for selecting most of the schedule specifics. Additional monitoring is mandated by Operational Safety Requirements (OSRs) and air and water discharge permits (40 CFR 61 and SPDES), which also require formal report generation. These specific cases are identified in the schedule under Monitoring/Reporting Requirements.

SUMMARY OF MONITORING PROGRAM CHANGES IMPLEMENTED IN 1988

Most of the sampling points added in 1987 had provided insufficient data to include in the 1987 annual environmental report. Significant 1988 program changes were limited to collection of 1988 data from the sample points (TLDs, air samplers, and water sample points) added in late 1987. A program review of the 1988 Environmental Surveillance activities will be reflected in the 1989 program. No new points were initiated in 1988.

SCHEDULE OF ENVIRONMENTAL SAMPLING

The following table presents a schedule of environmental sampling. Locations of the sampling points are shown on Figures A-1 through A-9. The headings for the table are explained in the following paragraphs. An index is provided to locate sample information and to provide an overview of sample types and names.

Sample Location and I.D. Code - The physical location where the sample is collected is described. The I.D. is a seven-character code which identifies the sample media as Air, Water, Soil/Sediment, Biological, or Direct Measurement, On- or Off-site, and describes the specific location (e.g., AFGRVAL is Air Off-site at Great Valley).

Monitoring/Reporting Requirements - The basis for monitoring that location and any additional references to permits or OSRs are noted.

Sampling Type/Medium - Describes collection method, and the physical characteristics of the media.

Collection Frequency - Sample collection frequency.

Total Annual Samples - Discrete physical samples collected annually, not including composites of collected samples.

Analysis Performed/Composite Frequency - Describes the individual analyses on the samples or composites of samples, and the frequency of analysis.

INDEX OF ENVIRONMENTAL MONITORING PROGRAM SAMPLE POINTS

On-Site Effluent - Air (Figure A-1)

On-Site Effluent - Water (Figure A-2)

On-Site Groundwater (Figure A-4)

On-Site Surface Water (Figure A-2)

Off-Site Groundwater (Figure A-8)

Off-Site Surface Water (Figure A-7)

*Not detailed on map.

*Not detailed on map

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Main Plant Ventilation Exhaust Stack **ANSTACK**	Airborne radioactive effluent point including LWTS and Vitrification Off-Gas	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and beta monitoring
	Required by: OSR/TR-GP-1 40 CFR 61 Reported: Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report Air Emissions Annual Report	Continuous off-line air particulate and iodine sampler Continuous off-line tritium (as water vapor) sampler	Weekly collection of filter paper, charcoal absorber, and desiccant	156	Filters for gross alpha/ beta, gamma isotopic* and H-3 weekly Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic; charcoal for I-129
Supernatant Treatment System (STS) Ventilation Exhaust **ANSTSTK**	Same as for ANSTACK				

* Weekly gamma isotopic only if gross activity rises significantly.

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Supercompactor Exhaust **ANSUPCV**	Airborne radioactive effluent point Required by: OSR/TR-GP-1 40 CFR 61 Reported: Annual Effluent and Onsite Discharge Report Air Emissions Annual Report	Continuous off-line air particulate monitor during operation (maximum of 26 operating weeks expected)	Continuous measurement of fixed filter, collected and replaced every seven operating days, or at least monthly when unit is operated	26	Real time beta monitoring Filters for gross alpha/ beta, gamma isotopic* upon collection Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic

* Weekly gamma isotopic only if gross activity rises significantly.

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

AMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cement Solidification System (CSS) Ventilation Exhaust **ANCSSTK**	Airborne radioactive effluent point Required by: OSR/TR-GP-1 40 CFR 61 Reported: Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report Air Emissions Annual Report	Continuous off-line air particulate monitor	Continuous measurement of fixed filter, replaced weekly	104	Real time alpha and beta monitoring
		Continuous off-line air particulate and iodine sampler	Weekly collection of filter paper and charcoal absorber	104	Filters for gross alpha/ beta, gamma isotopic* weekly Quarterly composites: filters for Sr-90, Pu/U isotopic, Am-241, gamma isotopic; charcoal for I-129
Contact Size Reduction Facility Exhaust **ANCSRFK**	Same as for ANCSSTK				

* Weekly gamma isotopic only if gross activity rises significantly.

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Lagoon 3 Discharge Weir **WNSP001**	Primary point of liquid effluent batch release Required by: OSR/TR-GP-2 SPDES Permit Reported: Monthly SPDES DMR Annual Effluent and Onsite Discharge Report	Grab Liquid	Daily, during Lagoon 3 discharge	40-80	Daily: gross beta, conductivity, pH. Every sixth daily sample: gross alpha/beta, H-3, Sr-90, gamma isotopic. Weighted monthly composite of daily samples: gross alpha/ beta, H-3, C-14, Sr-90, I-129, gamma isotopic, Pu/U isotopic, Am-241
	Annual Environmental Monitoring Report	Composite Liquid	Twice during discharge, near start, and near end	8-10	Two 24 hour composites for Al, NH_3, As, BOD-5, Fe, Zn, pH, suspended solids; SO_4, NO_3, NO_2, Cr^{+6}, Cd, Cu, Pb
		Grab Liquid	Twice during discharge, same as composite	8-10	Settleable solids, pH, cyanide, oil and grease
		Composite Liquid	Annually	1	Annually, a 24 hour composite for: Cr, Ni, Se, Ba, Sb
		Grab Liquid	Annually	1	Chloroform

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

AMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Erdman Brook at Security Fence **WNSP006**	Combined facility liquid discharge Required by: OSR/TR-GP-2 Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Continuous proportional sample liquid	*Weekly	52	Gross alpha/beta, H-3, pH, conductivity. Monthly composite: gamma isotopic and Sr-90. Quarterly composite: C-14, I-129, Pu/U isotopic, Am-241
Sanitary Waste Discharge **WNSP007**	Liquid effluent point for sanitary and utility plant combined discharge	24 hr composite liquid	3/month	36	Gross alpha/beta, H-3, suspended solids, NH_3, BOD-5, Fe
	Required by: SPDES Permit	Grab	Weekly	52	pH, settleable solids
	Reported: Monthly SPDES DMR	Grab	Annually	1	Chloroform
	Monthly Environmental Monitoring Trend Analysis Annual Effluent and Onsite Discharge Report Annual Environmental Monitoring Report				

*Samples to be split with NYSDOH

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
N.E. Swamp Drainage **WNSWAMP**	Site surface drainage	Grab liquid	Monthly *WNSWAMP only	24	Gross alpha/beta, H-3, pH
North Swamp Drainage **WNSW74A**	Reported: Annual Effluent and Onsite Discharge Report				
French Drain **WNSP008**	Drains subsurface water from LLWT lagoon area	Grab liquid	3/month	36	pH, conductivity, BOD-5, Fe
	Reported: Monthly SPDES DMR		Monthly	12	Gross alpha/beta, H-3
	Annual Effluent and Onsite Discharge Report		Annually	1	Ag, Zn

*Replicate sample to NYSDOH

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site groundwater HLW Tank GW Monitoring Unit - Wells: **WNW** **80-2** **86-7** **86-8** **86-9** **86-12*** Surface: **WNDMPNE*** Lagoon GW Monitoring Unit - Wells: **WNW** **86-6** **86-3** **86-4** **86-5** **80-5** **80-6** Surface: **WNGSEEP** **WNSP008** NDA GW Monitoring Unit - Wells: **WNW** **83-1D** **86-10** **86-11** **82-1D**	Groundwater monitoring wells around site waste management units <u>Reported</u>: Annual Environmental Monitoring Report	Grab liquid	Semiannual	144	Gross alpha/beta, H-3, gamma isotopic, pH conductivity, chloride, sulfate, phenols, nitrate, TOC, TOH, As, Ba, Cd, Cr, Fe, Pb, Mn, Hg, Se, Ag, Na

*Serves former Cold Dump

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

AMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site groundwater Facility/Plant Area Wells: **WNW** **80-3** **80-4**	Groundwater monitoring wells around site facilities Reported: Annual Environmental Monitoring Report	Grab liquid	Semiannual	88	Gross alpha/beta, H-3, gamma isotopic, pH conductivity
NDA Area Wells: **WNW** **82-1A** **82-1B** **82-1C** **82-2B** **82-2C** **82-3A** **82-4A1** **82-4A2** **82-4A3**					
Fuel Storage Tank Subsurface Monitoring Well: **WNW** **86-13**				2	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity, phenols, TOC, benzene, toluene, xylene

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Franks Creek E of SDA **WNFRC67**	Drains NYS Low-Level Waste Disposal Area Reported: Internal review NYSERDA	Grab liquid	*Monthly	12	Gross alpha/beta, H-3, pH
Erdman Brook N of Disposal Areas **WNERB53**	Drains NYS and WVDP disposal areas Reported: Internal Review NYSERDA	Grab liquid	Weekly *Monthly to NYSDOH	52	Gross alpha/beta, H-3, pH
Ditch N of WVDP NDA & SDA **WNNDADR**	Drains WVDP disposal and storage area Reported: Internal Review	Composite continuous liquid	Weekly	104	Monthly/Composite: gross alpha/beta, gamma isotopic, H-3, pH, Quarterly composite: Sr-90, I-129
Drainage S of Drum Cell **WNDCELD**	Same as WNNDADR, except sample collection is weekly grab				

*Replicate sample to NYSDOH

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
On-site Standing Water (ponds not receiving effluent)*	Water within vicinity of plant airborne or ground water effluent	Grab liquid	Annually	7-10	Gross alpha/beta, H-3, pH, conductivity, chloride, Fe, Mn, Na, phenols, sulfate
Test Pit N of HLW Area **WNSTAW1** Slough SW of RTS Drum Cell **WNSTAW2** Pond SE of Heinz Road **WNSTAW3** Border Pond S of AFRT240 **WNSTAW4** Border Pond SW of DFTLD13 **WNSTAW5** Borrow Pit NE of Project Facilities **WNSTAW6** Pond SW of Project Facilities W of Rock Springs Road **WNSTAW7** Slough N of Quarry Creek **WNSTAW8** North Reservoir Near Intake **WNSTAW9** Background Pond at Sprague Brook Maintenance Building **WNSTAWB**	<u>Reported</u>: Internal Review				

*Number of points sampled will depend upon on-site ponding conditions during the year.

1988 EFFLUENT AND ON-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
:ondensate and :ooling Water ıitch **WNSP005**	Combined drainage from facility yard area Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
:ooling Tower ßasin **WNCOOLW**	Cools plant utility steam system water Reported: Internal Review	Grab liquid	Monthly	12	Gross alpha/beta, H-3, pH
;ite potable water **WNDRNKW**	Source of water within site perimeter Reported Internal Review	Grab liquid	Monthly Annually	12 2	Gross alpha/beta, H-3, pH, conductivity Toxic metals, pesticides chemical pollutants
;DA Holding .agoon **WNSP003**	State disposal area holding lagoon Reported: Annual Environmental Monitoring Report NYSERDA	Grab liquid	Annually (as required)	1	Gross alpha/beta, H-3, C-14, pH, gamma isotopic, Sr-90, I-129, Pu/U isotopic

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek at Felton Bridge **WFFELBR**	Unrestricted surface waters receiving plant effluents Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Flow weighted continuous liquid	Weekly *Monthly Composite	52	Weekly for gross alpha/beta, H-3, pH; Monthly composite for gamma isotopic and Sr-9
Buttermilk Creek, Upstream of Cattaraugus Creek Confluence at Thomas Corners Road **WFBCTCB**	Restricted surface waters receiving plant effluents Reported: Annual Environmental Monitoring Report	Composite continuous liquid	*Biweekly	26	Monthly for gross alpha/beta, H-3, pH; Quarterly composite for gamma isotopic and Sr-9
Buttermilk Creek near Fox Valley **WFBCBKG**	Restricted surface water background Reported: Monthly Environmental Monitoring Trend Analysis Annual Environmental Monitoring Report	Composite continuous liquid	*Biweekly	26	Monthly for gross alpha/beta, H-3; Quarterly composite for gamma isotopic and Sr-9

*Samples to be split with NYSDOH

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Wells near WVDP outside WNYNSC Perimeter 3.0 km WNW WFWEL01 1.5 km NW WFWEL02 4.0 km NW WFWEL03 3.0 km NW WFWEL04 2.5 km SW WFWEL05 29 km S WFWEL06 (background) 4.0 km NNE WFWEL07 2.5 km ENE WFWEL08 3.0 km SE WFWEL09 7.0 km N WFWEL10	Drinking supply ground water near facility Reported: Annual Environmental Monitoring Report	Grab liquid	Biennially	6 (5 + Background well each year of collection)	Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
3.0 km SSE at Fox Valley **AFFXVRD** 3.7 km NNW at Thomas Corners Road **AFTCORD** 2.0 km NE on Route 240 **AFRT240+** 1.5 km NW on Rock Springs Road **AFRSPRD****+ 29 km S at Great Valley (background) **AFGRVAL****+ 7 km at Springville **AFSPRVL** 6 km SSE at West Valley **AFWEVAL** 50 km W at Dunkirk (background) **AFDNKRK** 2.3 km SW on Dutch Hill Road **AFBOEHN+**	Particulate air samples around WNYNSC perimeter Required by: DOE 5484.1 Reported: Annual Environmental Report Monthly Environmental Monitoring Trend Analysis+	Continuous air particulate Continuous H-3, charcoal**	Weekly	660	Weekly (each filter) gross alpha/beta, H-3 (on 3 stations) Quarterly: (Each station) composite filters for Sr-90, gamma isotopic; I-129 (on 3 stations)

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
2.5 km SW **AFDHFOP** 3.0 km SSE **AFFXFOP** 3.7 km NNW **AFTCFOP** 2.0 km NE **AF24FOP**	Collection of fallout particulate and precipitation around WNYNSC perimeter Reported: Annual Environmental Report	Integrating liquid	Monthly	48	Gross alpha/beta, H-3, pH
Surface soil (at each of nine air samplers plus 26 km SSW at Little Valley) **SFSOL-Series**	Long-term fallout accumulation Reported: Annual Environmental Monitoring Report	Surface plug composite soil	Triennially	10 (year of collection)	Gamma isotopic, Sr-90, Pu-239, Am-241
Buttermilk Creek at Thomas Corners Road **SFTCSED**** Buttermilk Creek at Fox Valley Road (back-ground) **SFBCSED**** Cattaraugus Creek at Springville Dam **SFSDSED** Cattaraugus Creek at Bigelow Bridge (back-ground) **SFBISED** Cattaraugus Creek at Felton Bridge **SFCCSED**	Deposition in sediment downstream of facility effluents Reported: Annual Environmental Monitoring Report	Grab stream sediment	Semiannually *1st sample of SFBCSED and SFSDSED each spring **Annually	10 2	Gross alpha/beta, isotopic gamma and Sr-90 U/Pu isotopic, Am-241

*Sample to be split with NYSDOH

**Analysis on one of two semiannual collections.

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
Cattaraugus Creek downstream of the Buttermilk Creek confluence **BFFCATC** Cattaraugus Creek downstream of Springville Dam **BFFCATD** Control Sample from nearby stream not affected by WVDP (7 km or more upstream of site effluent point) **BFFCTRL**	Fish in waters downstream of facility effluents Reported: Annual Environmental Monitoring Report	Individual collection, biological	Semiannually *BFFCATC and BFFCTRL shared with NYSDOH, BFFCATD as sample is available	6 (each sample is 10 fish)	Isotopic gamma and Sr- in edible portions of each individual fish.
Dairy Farm, 3.8 km NNW **BFMREED** Dairy Farm, 1.9 km WNW **BFMCOBO** Dairy Farm SE of site **BFMWIDR** Dairy Farm 2.5 km SSW **BFMHAUR** Control location 25 km S **BFMCTLS** Control location, 30 km **BFMCTLN**	Milk from animals foraging around facility perimeter Reported: Annual Environmental Monitoring Report	Grab biological	Monthly (*BFMREED, BFMCOBO, BFMCTLS, BFMCTLN) Annual (BFMWIDR, BFMHAUR)	48 2	Gamma isotopic, Sr-90, 3 and I-129 on annual samples and quarterly composites of monthly samples

*Samples shared with NYSDOH

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
(3) Nearby locations **BFVNEAR** (3) Remote locations (16 km or more from facility) **BFVCTRL**	Fruit and vegetables grown near facility perimeter downwind if possible Reported: Annual Environmental Monitoring Report	Grab biological	*Annually, at harvest	6	Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture
Beef cattle forage from near site location N **BFHNEAR** Milk cow forage from control south location or north location **BFHCTLS** or **BFHCTLN**		Grab biological	Annually	2	Gamma isotopic, Sr-90
Beef animal from nearby farm in downwind direction **BFBNEAR** Beef animal from control location (16 km or more from facility) **BFBCTRL**	Meat-Beef foraging near facility perimeter, downwind if possible Reported: Annual Environmental Monitoring Report	Grab biological	Semiannually *2nd sample (each fall) to NYSDOH	4	Gamma isotopic and Sr-90 analysis of meat
In vicinity of the site (3) **BFDNEAR**	Meat-Deer foraging near facility perimeter Reported: Annual Environmental Monitoring Report	Individual collection biological	*Annually, during hunting season	3	Gamma isotopic and Sr-90 analysis of meat
Control animals (3) (16 km or more from facility) **BFDCTRL**			*During year as available	3	

*Sample to be split with NYSDOH

1988 OFF-SITE MONITORING PROGRAM

SAMPLE LOCATION AND I.D. CODE	MONITORING/REPORTING REQUIREMENTS	SAMPLING TYPE/MEDIUM	COLLECTION FREQUENCY	TOTAL ANNUAL SAMPLES	ANALYSES PERFORMED/ COMPOSITE FREQUENCY
DFTLD Series Thermoluminescent Dosimetry (TLD) (16) at each of 16 compass sectors, at nearest accessible perimeter point #1-16 1500 m NW (downwind receptor) #20 "5 Points" land-fill, 19 km SW (background) #17 Great Valley, 29 km S (background) #23 Springville 7 km N #21 West Valley 5 km SSE #22 Dunkirk, 50 km (background) #37 (3) at corners of SDA #18,19,33 (9) at security fence around site #24,26-34 (5) On-site near operational areas #35,36,38-40 Rock Springs Road 500 m NNW of plant #25 DNTLD (on-site)	Direct radiation around facility Reported: Annual Environmental Monitoring Report	Integrating LiF TLD	Quarterly	160	Quarterly gamma radiation exposure

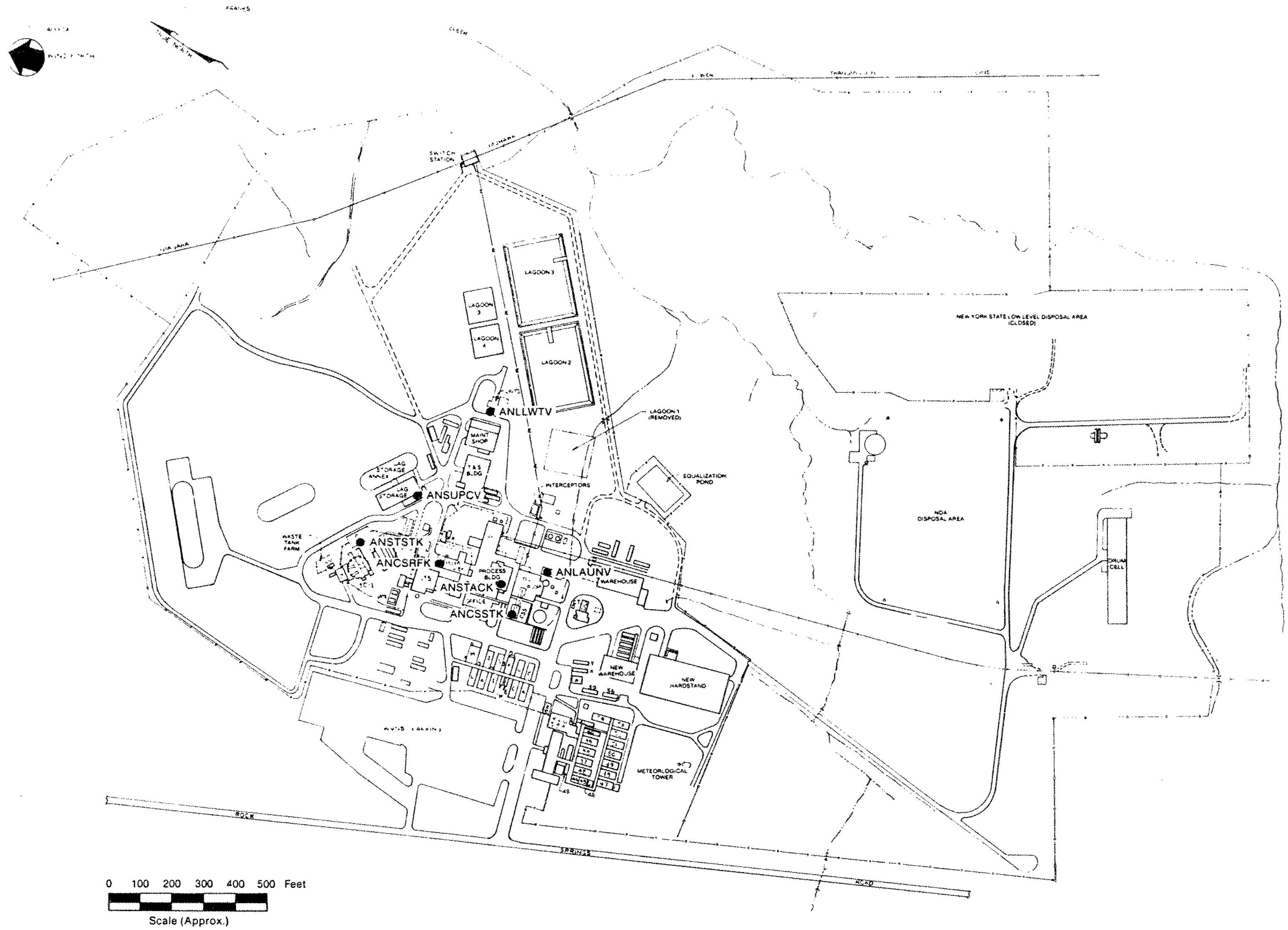

Figure A-1. Location of Air Effluent Points on Site.

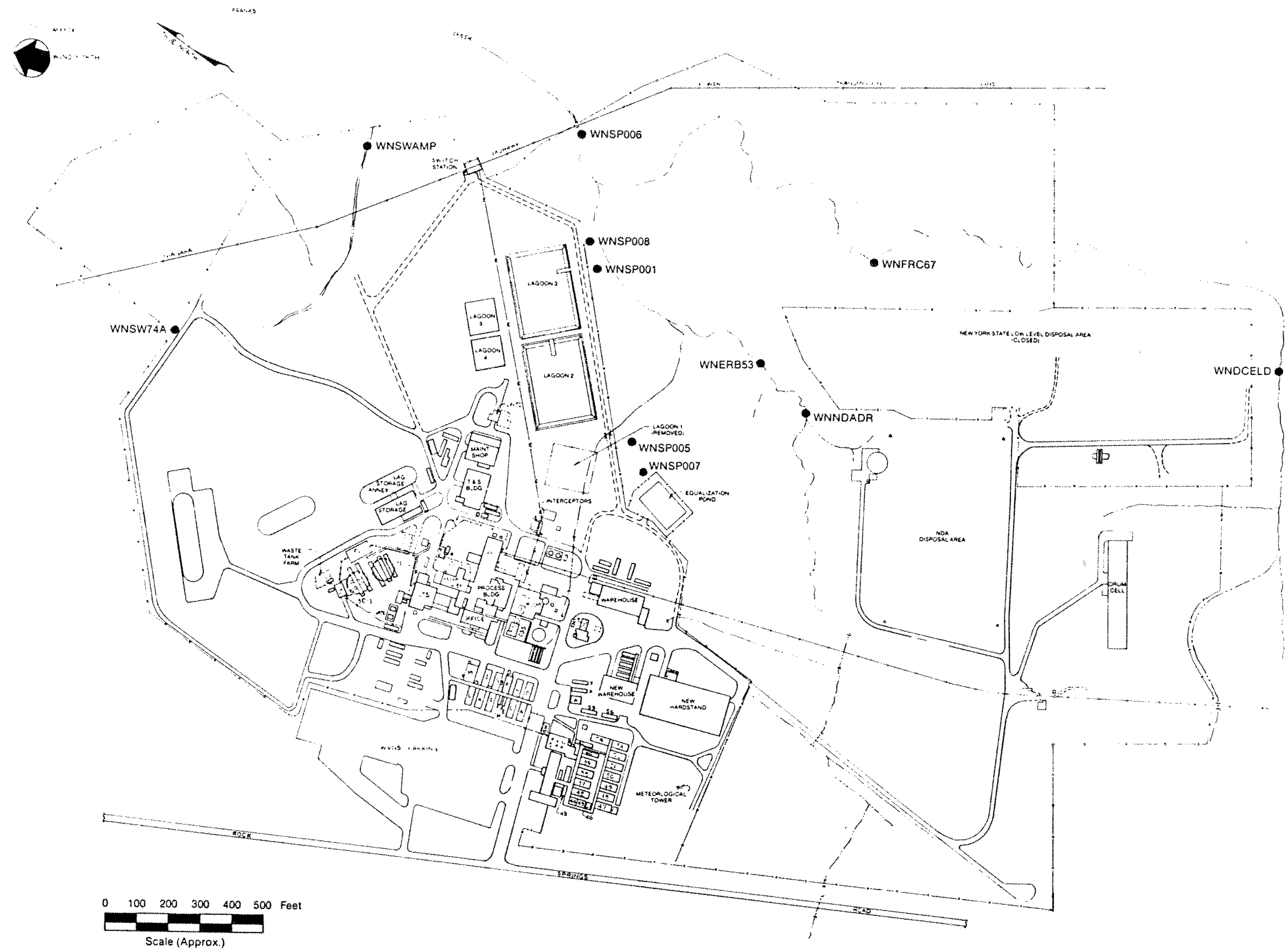

Figure A-2. Location of Surface Water Monitoring Points on Site.

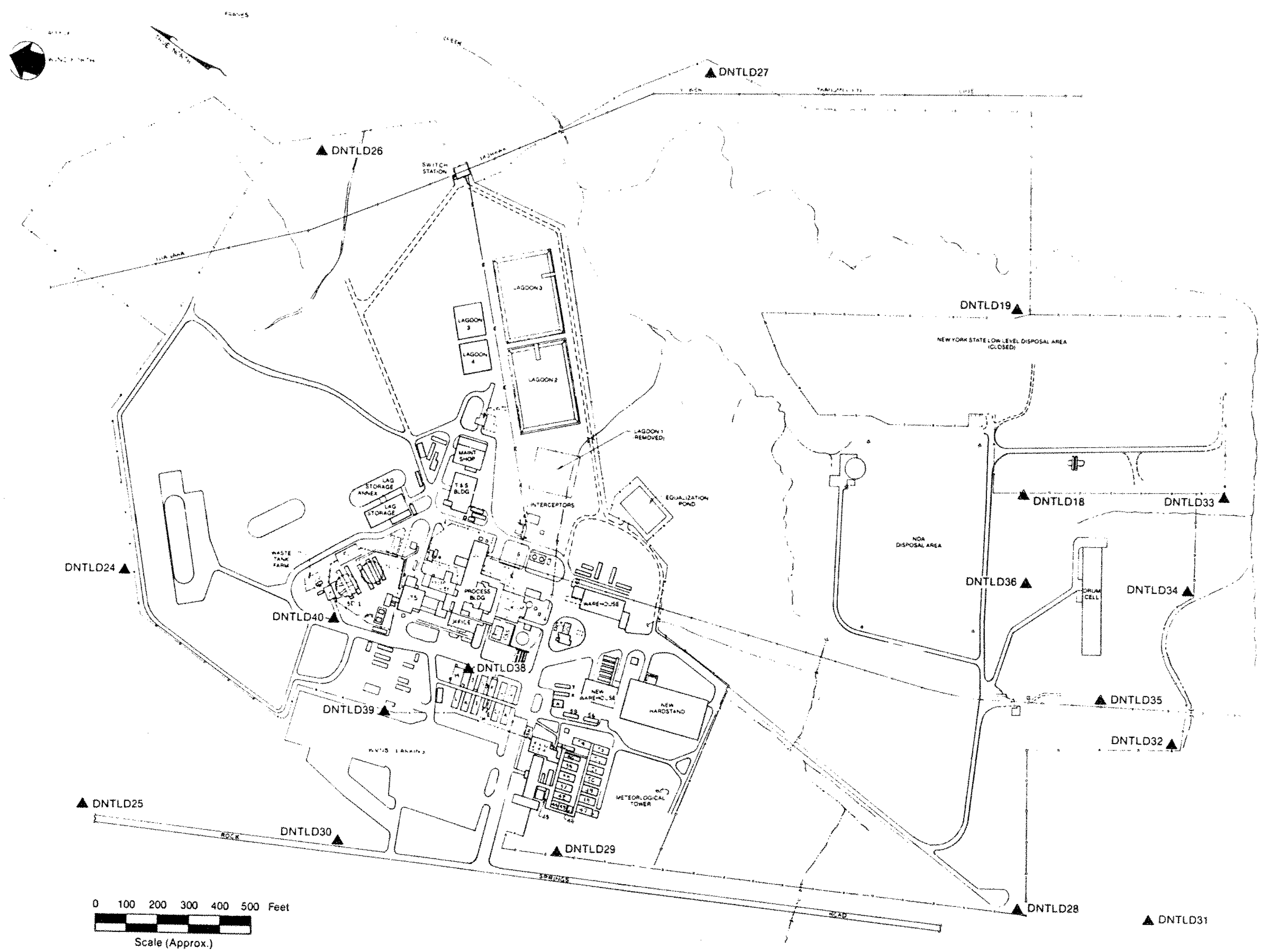

Figure A-3. Location of On-Site Thermoluminescent Dosimetry (TLD).

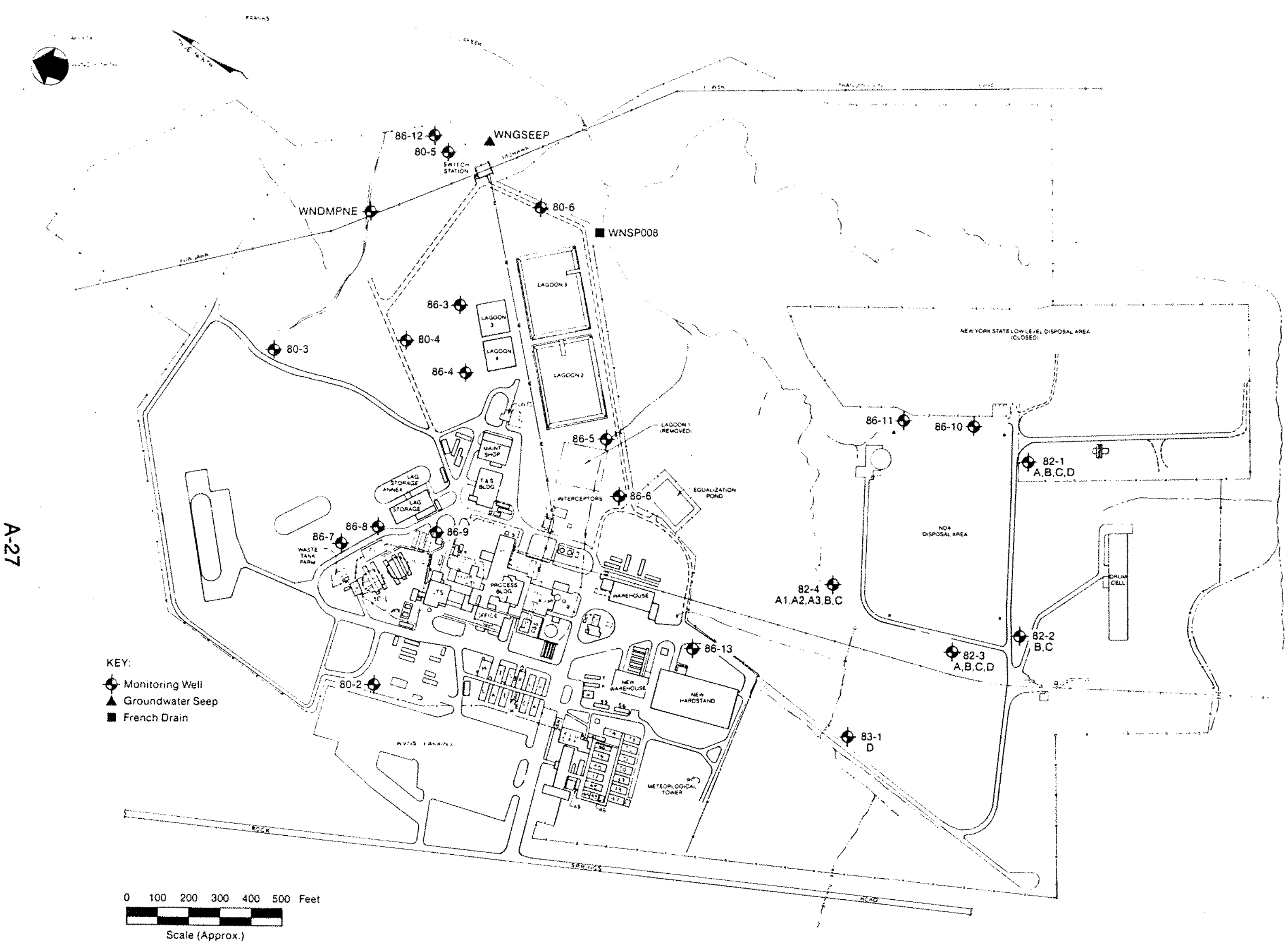

Figure A-4. Location of Groundwater Monitoring Locations on Site.

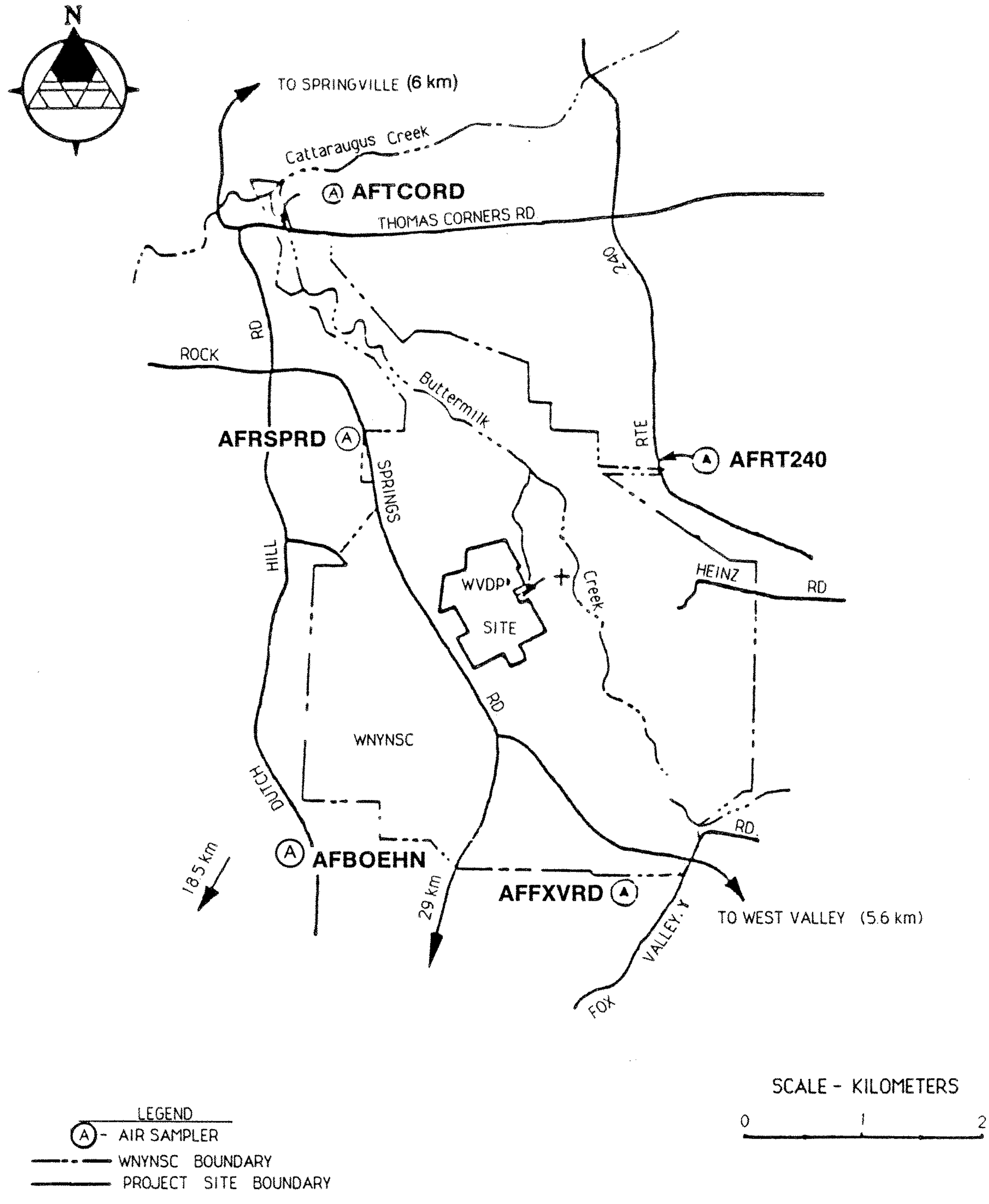

Figure A-5. Location of Perimeter Air Samplers.

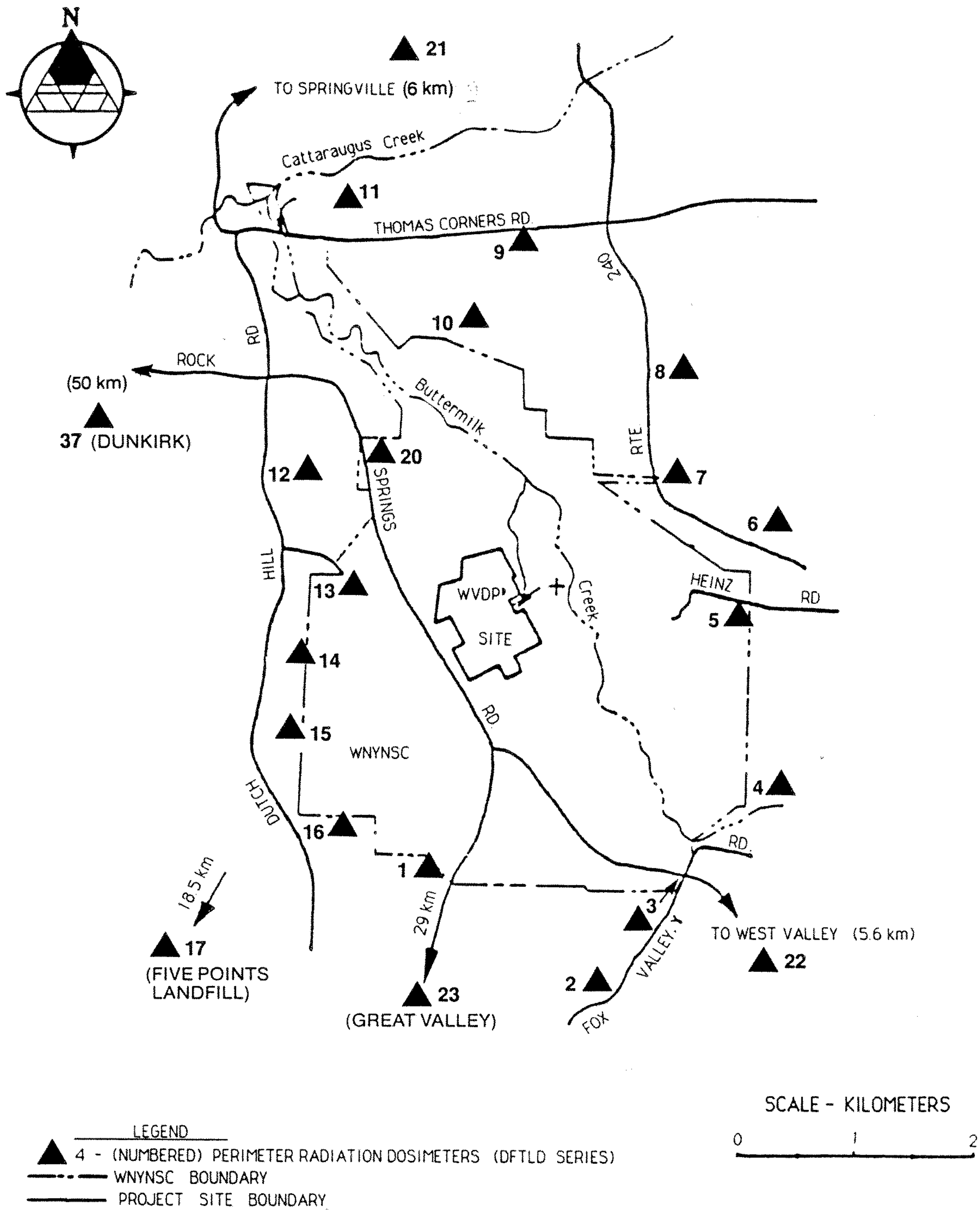

Figure A-6. Location of Off-Site Thermoluminescent Dosimetry (TLD).

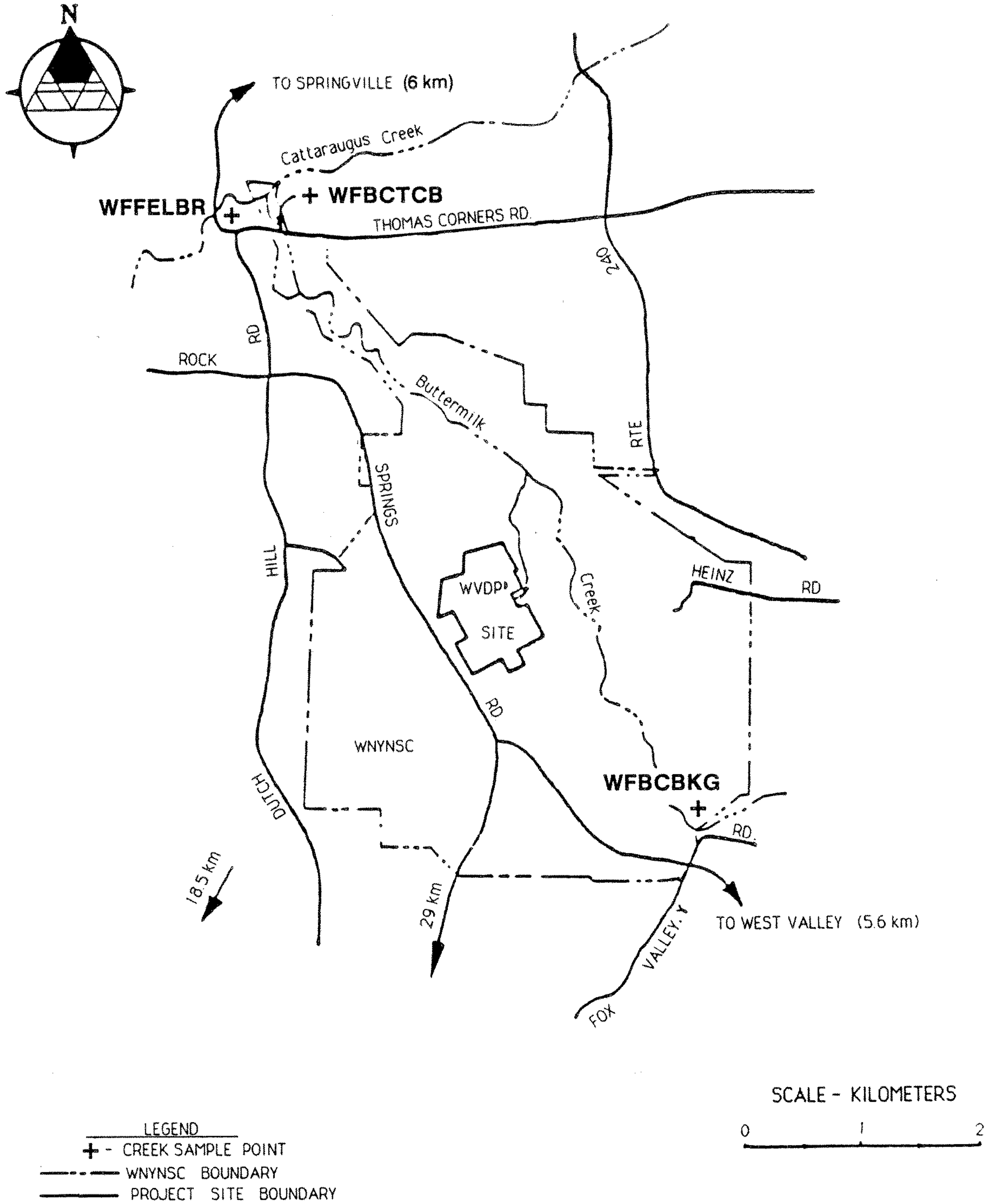

Figure A-7. Location of Off-Site Surface Water Samplers.

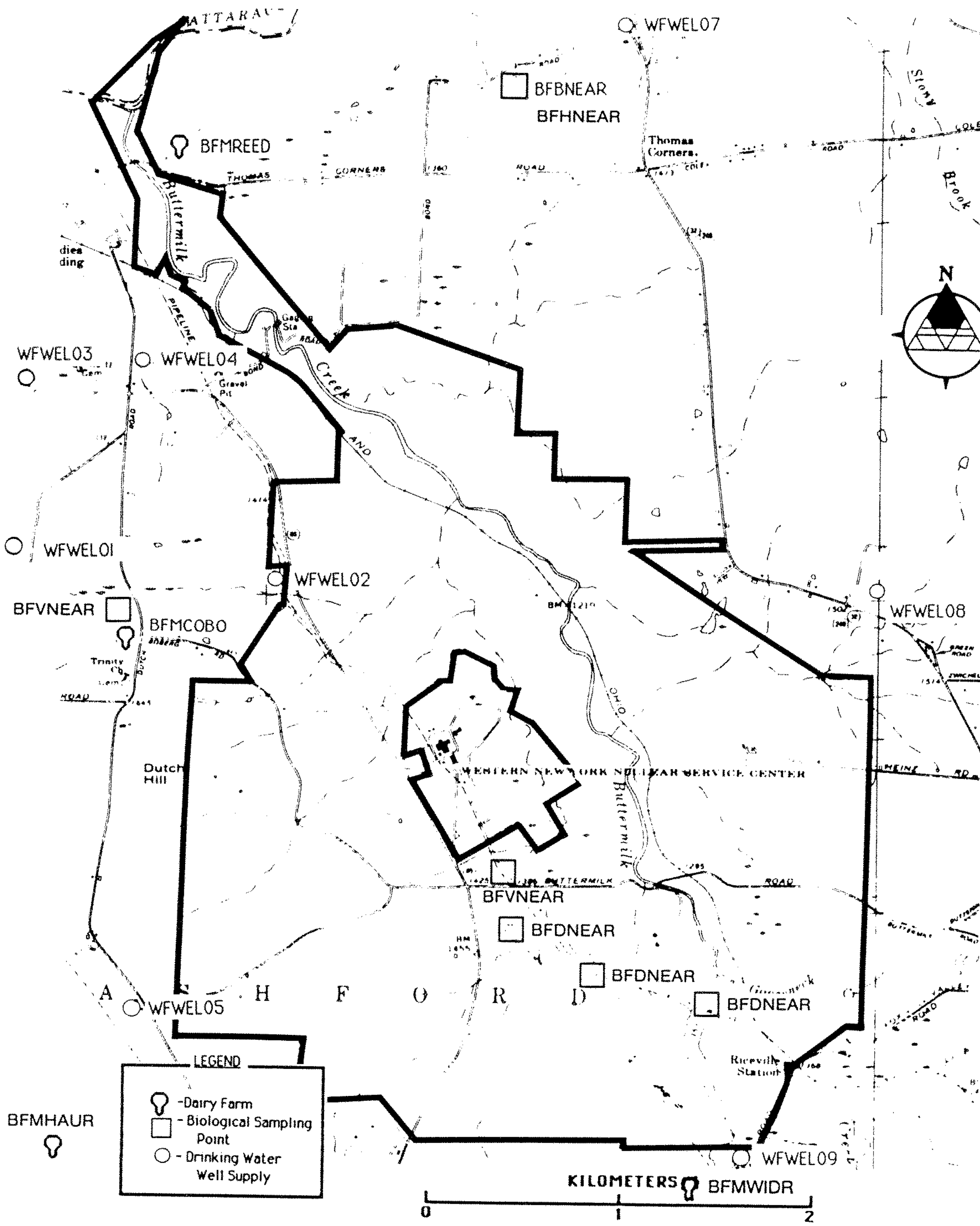

Figure A-8. Near-Site Drinking Water and Biological Sample Points - 1988.

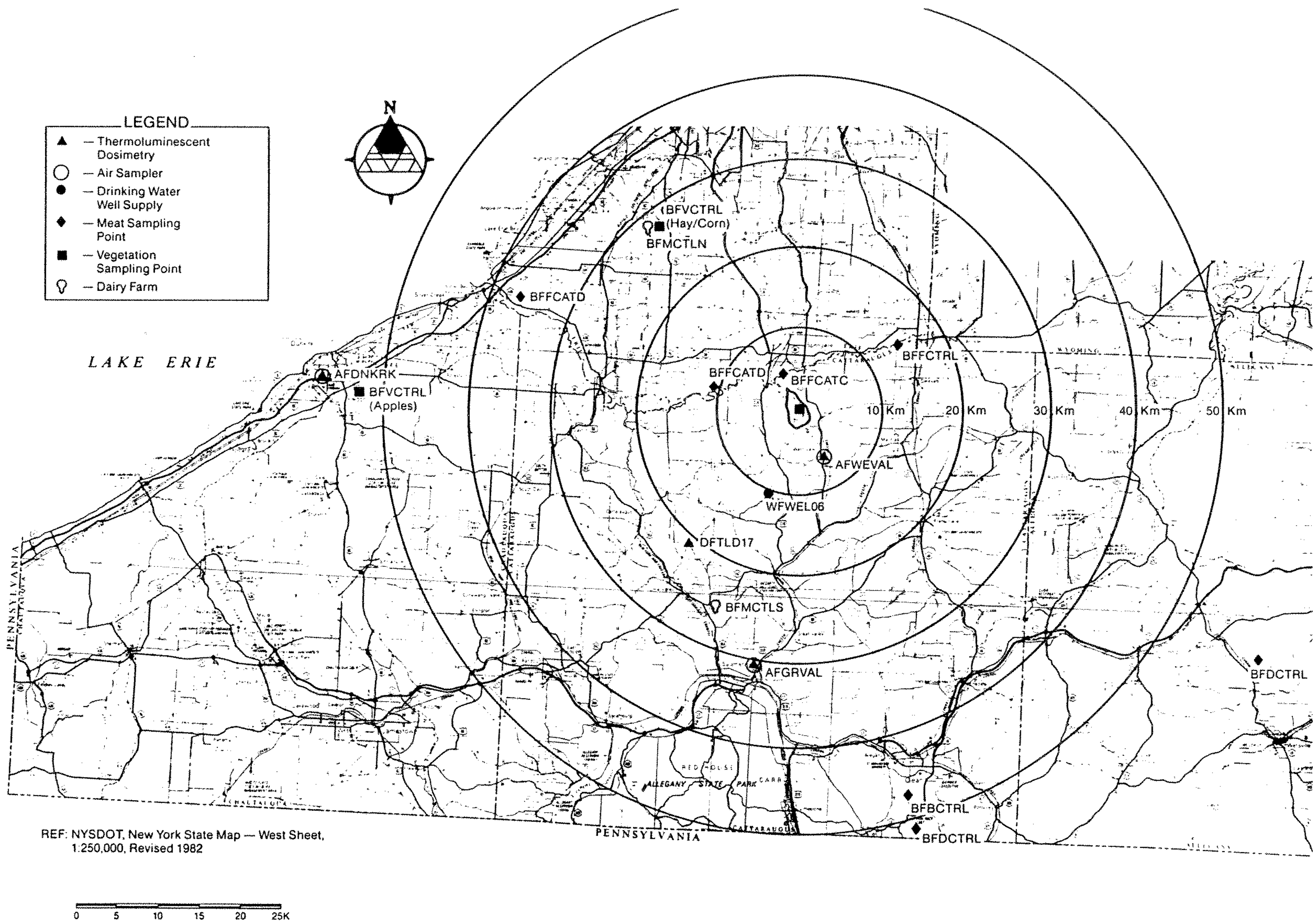

Figure A-9. Environmental Sample Points more than 5 km from the WVDP Site.

APPENDIX B
DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

Annual Effective Dose Equivalent Radiation Standards for Protection of the Public*

Continuous Exposure of Any Member of the Public	100 mrem/yr (1 mSv/yr)
Occasional Annual Exposure (less than 5 years duration)	500 mrem/yr (5 mSv/yr)

DOE Derived Concentration Guides (DCG) for Ingestion of Drinking Water and Inhaled Air (μCi/mL)

Radionuclide	In Air	In Water	Radionuclide	In Air	In Water
H-3	1 E-07	2 E-03	Eu-152	5 E-11	2 E-05
C-14	6 E-09	7 E-05	Eu-154	5 E-11	2 E-05
Fe-55	5 E-09	2 E-04	Eu-155	3 E-10	1 E-04
Co-60	8 E-11	5 E-06	Th-232	7 E-15	5 E-08
Ni-63	2 E-09	3 E-04	U-233	9 E-14	5 E-07
Sr-90	9 E-12	1 E-06	U-234	9 E-14	5 E-07
Zr-93	4 E-11	9 E-05	U-235	1 E-13	6 E-07
Nb-93m	4 E-10	3 E-04	U-236	1 E-13	5 E-07
Tc-99	2 E-09	1-E-04	U-238	1 E-13	6 E-07
Ru-106	3 E-11	6 E-06	Np-239	5 E-09	5 E-05
Rh-106m	6 E-08	2 E-04	Pu-238	3 E-14	4 E-08
Sb-125	1E-09	5 E-05	Pu-239	2 E-14	3 E-08
Te-125m	2 E-09	4 E-05	Pu-240	2 E-14	3 E-08
I-129	7 E-11	5 E-07	Pu-241	1 E-12	2 E-06
Cs-134	2 E-10	2 E-06	Am-241	2 E-14	3 E-08
Cs-135	3 E-09	2 E-05	Am-243	2 E-14	3 E-08
Cs-137	4 E-10	3 E-06	Cm-243	3 E-14	5 E-08
Pm-147	3 E-10	1 E-04	Cm-244	4 E-14	6 E-08
Sm-151	4 E-10	4 E-04	Gross Alpha (as Am-241)	2 E-14	3 E-08
			Gross Beta (as Ra-228)	3 E-12	1 E-07

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* As transmitted by memorandum from John C. Tseng, Acting Director, Office of Environmental Guidance and Compliance, U.S. Department of Energy, dated November 4, 1987.

APPENDIX C-1
SUMMARY OF WATER AND SEDIMENT MONITORING DATA

TABLE C-1.1.1

TOTAL RADIOACTIVITY CONCENTRATIONS OF LIQUID EFFLUENTS RELEASED
FROM WVDP LAGOON 3 IN 1988
(CURIES)

	ALPHA	BETA	H-3	C-14	Sr-90	I-129	Cs-137
1ST QTR	8.39 ± 6.2 E-04	1.48 ± 0.3 E-02	2.38 ± 0.2 E-01	<1.2 E-03	2.22 ± 0.2 E-03	1.29 ± 0.1 E-04	1.10 ± 0.2 E-02
2ND QTR	7.01 ± 3.3 E-04	3.13 ± 0.7 E-03	1.15 ± 0.1 E-01	<3.9 E-04	6.81 ± 0.7 E-04	2.82 ± 0.3 E-05	1.24 ± 0.9 E-03
3RD QTR	***NO RELEASE THIS PERIOD***						
4TH QTR	7.05 ± 3.5 E-04	6.06 ± 1.0 E-03	3.25 ± 0.1 E-01	<2.7 E-03	5.05 ± 0.4 E-04	2.92 ± 0.7 E-05	3.68 ± 3.6 E-04
1988 TOTALS	2.25 ± 0.8 E-03	2.45 ± 0.3 E-02	6.78 ± 0.2 E-01	<3.0 E-03	3.41 ± 0.2 E-03	1.86 ± 0.1 E-04	1.26 ± 0.2 E-02
AVERAGE (μCi/mL)	7.41 E-08	8.07 E-07	2.23 E-05	<9.9 E-08	1.12 E-07	6.13 E-09	4.15 E-07

	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
1ST QTR	3.68 ± 0.8 E-04	1.32 ± 0.5 E-05	1.35 ± 0.3 E-04	2.72 ± 1.2 E-07	2.60 ± 1.2 E-07	1.19 ± 0.2 E-06
2ND QTR	3.25 ± 0.3 E-04	4.25 ± 0.6 E-06	1.21 ± 0.1 E-04	2.79 ± 0.9 E-07	8.84 ± 5.0 E-08	1.22 ± 0.5 E-07
3RD QTR	***NO RELEASE THIS PERIOD***					
4TH QTR	3.19 ± 0.3 E-04	7.60 ± 3.6 E-06	9.87 ± 1.4 E-05	3.97 ± 3.9 E-07	<2.7 E-07	2.54 ± 1.6 E-07
1988 TOTALS	1.01 ± 0.1 E-03	2.51 ± 0.6 E-05	3.55 ± 0.3 E-04	9.48 ± 4.2 E-07	3.48 ± 3.0 E-07	1.57 ± 0.3 E-06
AVERAGE (μCi/mL)	3.33 E-08	8.27 E-10	1.17 E-08	3.12 E-11	1.15 E-11	5.17 E-10

TABLE C-1.1.2

COMPARISON OF 1988 LAGOON 3 LIQUID EFFLUENT RADIOACTIVITY CONCENTRATIONS WITH DOE GUIDELINES

ISOTOPE	TOTAL µCi RELEASED[a]	AVG CONC (µCi/mL)	DCG (µCi/mL)	PERCENT OF DCG
Alpha	2.25 E+03	7.41 E-08	NA[b]	--
Beta	2.45 E+04	8.07 E-07	NA[b]	--
H-3	6.78 E+05	2.23 E-05	2.0 E-03	1.1
C-14	<3.0 E+03	<9.9 E-08	7.0 E-05	0.1
Sr-90	3.41 E+03	1.12 E-07	1.0 E-06	11.2
I-129	1.86 E+02	6.13 E-09	5.0 E-07	1.2
Cs-137	1.26 E+04	4.15 E-07	3.0 E-06	13.8
U-234[c]	1.01 E+03	3.33 E-08	5.0 E-07	6.7
U-235[c]	2.51 E+01	8.27 E-10	6.0 E-07	0.1
U-238[c]	3.55 E+02	1.17 E-08	6.0 E-07	2.0
Pu-238	9.48 E-01	3.12 E-11	4.0 E-08	<0.1
Pu-239	3.48 E-01	1.15 E-11	3.0 E-08	<0.1
Am-241	1.57 E+00	5.17 E-11	3.0 E-08	0.2
Total				36.6[d]

Notes:

[a] Total Volume Released = 3.03 E+10 mL, measured at actual on-site release point.

[b] Derived Concentration Guides (DCG) are not specified for gross alpha or beta activity.

[c] Total U(µgm) = 1.07 E+09; Average U(mg/L) = 3.57 E-02

[d] Total percent DCG for specific measured radionuclides

TABLE C-1.2

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
UPSTREAM OF WVDP AT FOX VALLEY (WFBCBKG)
(μCi/mL)

1988	ALPHA	BETA	H-3	SR-90	CS-137
JAN	<7.3 E-10	2.24 ± 1.2 E-09	<1.0 E-07		
FEB	<1.0 E-09	3.10 ± 1.2 E-09	<1.0 E-07		
MAR	<7.6 E-10	5.37 ± 1.2 E-09	<1.0 E-07		
1ST QTR				<1.6 E-09	<2.1 E-08
APR	<9.9 E-10	4.08 ± 1.0 E-09	<1.0 E-07		
MAY	<7.8 E-10	3.44 ± 1.0 E-09	<1.0 E-07		
JUN	<9.1 E-10	4.25 ± 1.1 E-09	<1.0 E-07		
2ND QTR				3.64 ± 1.5 E-09	<2.1 E-08
JUL	<6.4 E-10	3.99 ± 1.1 E-09	<1.0 E-07		
AUG	1.80 ± 1.3 E-09	3.30 ± 1.0 E-09	<1.0 E-07		
SEP	<8.6 E-10	3.65 ± 1.0 E-09	<1.0 E-07		
3RD QTR				2.35 ± 1.4 E-09	<2.1 E-08
OCT	<9.8 E-10	3.74 ± 1.0 E-09	<1.0 E-07		
NOV	2.06 ± 1.4 E-09	3.40 ± 1.0 E-09	<1.0 E-07		
DEC	<5.0 E-10	3.44 ± 1.1 E-09	<1.0 E-07		
4TH QTR				1.49 ± 1.2 E-09	<2.1 E-08

TABLE C-1.3

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF WVDP AT THOMAS CORNERS (WFBCTCB)
(μCi/mL)

1988	ALPHA	BETA	H-3	SR-90	CS-137
JAN	<1.3 E-09	5.61 ± 1.4 E-09	<1.0 E-07		
FEB	<1.3 E-09	4.87 ± 1.4 E-09	<1.0 E-07		
MAR	9.22 ± 9.0 E-10	3.79 ± 1.0 E-09	<1.2 E-07		
1ST QTR				<1.7 E-09	<2.1 E-08
APR	1.79 ± 1.3 E-09	5.08 ± 1.1 E-09	<1.0 E-07		
MAY	<5.4 E-10	4.52 ± 1.1 E-09	1.47 ± 1.2 E-07		
JUN	<9.0 E-10	7.37 ± 1.4 E-09	<1.0 E-07		
2ND QTR				3.23 ± 1.5 E-09	<2.1 E-08
JUL	<6.9 E-10	7.61 ± 1.4 E-09	<1.0 E-07		
AUG	<7.6 E-10	7.37 ± 1.4 E-09	<1.0 E-07		
SEP	1.41 ± 1.2 E-09	8.16 ± 1.4 E-09	<1.0 E-07		
3RD QTR				4.14 ± 1.6 E-09	<2.1 E-08
OCT	<8.0 E-10	7.24 ± 1.3 E-09	<1.0 E-07		
NOV	<1.0 E-09	4.23 ± 1.1 E-09	<1.0 E-07		
DEC	<8.8 E-10	5.47 ± 1.2 E-09	<1.0 E-07		
4TH QTR				2.64 ± 1.5 E-09	<2.1 E-08

TABLE C-1.4.1

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF WVDP AT FRANKS CREEK (WNSP006)
(μCi/mL)

1988	ALPHA	BETA	H-3
JAN	<4.2 E-09	1.49 ± 0.1 E-07	2.51 ± 0.2 E-06
FEB	<9.7 E-10	2.55 ± 0.2 E-08	2.02 ± 1.2 E-07
MAR	1.24 ± 1.2 E-09	1.89 ± 0.2 E-08	3.01 ± 1.3 E-07
1ST QTR			
APR	<1.5 E-09	4.32 ± 0.3 E-08	9.08 ± 1.4 E-07
MAY	<9.8 E-10	1.98 ± 0.2 E-08	<1.0 E-07
JUN	5.89 ± 3.0 E-09	5.14 ± 0.3 E-08	2.50 ± 1.7 E-07
2ND QTR			
JUL	<1.4 E-09	4.09 ± 0.3 E-08	2.70 ± 1.2 E-07
AUG	<1.3 E-09	3.64 ± 0.3 E-08	3.11 ± 1.3 E-07
SEP	<1.1 E-09	3.99 ± 0.3 E-08	2.09 ± 1.2 E-07
3RD QTR			
OCT	2.81 ± 2.1 E-09	5.37 ± 0.3 E-08	2.56 ± 0.2 E-06
NOV	<1.3 E-09	2.17 ± 0.2 E-08	1.22 ± 1.1 E-07
DEC	<1.0 E-09	1.99 ± 0.2 E-08	1.40 ± 1.1 E-07
4TH QTR			

TABLE C-1.4.2

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF WVDP AT FRANKS CREEK (WNSP006)
(μCi/mL)

988	C-14	Sr-90	I-129	C-137	U-234
T QTR	<7.0 E-08	1.82 ± 0.3 E-08	<5.0 E-10	1.58 ± 0.5 E-07	1.28 ± 0.3 E-09
D QTR	1.20 ± 0.5 E-07	1.81 ± 0.3 E-08	<5.0 E-10	5.17 ± 4.6 E-08	1.81 ± 1.5 E-09
D QTR	<3.5 E-06	2.16 ± 0.3 E-08	2.73 ± 1.4 E-09	4.73 ± 2.1 E-08	4.10 ± 1.6 E-10
H QTR	<2.1 E-07	1.02 ± 0.1 E-08	<2.0 E-09	6.92 ± 4.3 E-08	1.25 ± 0.4 E-09

	U-235	U-238	Pu-238	Pu-239	Am-241
T QTR	<1.4 E-11	5.70 ± 1.3 E-10	2.58 ± 1.7 E-11	2.35 ± 1.7 E-11	<1.2 E-11
D QTR	4.86 ± 4.8 E-11	7.02 ± 5.8 E-10	1.79 ± 1.3 E-11	6.32 ± 2.2 E-11	2.39 ± 1.3 E-11
D QTR	<2.0 E-10	2.50 ± 1.3 E-10	<2.0 E-10	<2.0 E-10	3.00 ± 2.0 E-10
H QTR	<2.9 E-10	6.36 ± 2.8 E-10	<5.0 E-11	7.84 ± 4.9 E-11	6.57 ± 2.8 E-10

TABLE C-1.5

RADIOACTIVITY CONCENTRATIONS IN SURFACE WATER
DOWNSTREAM OF BUTTERMILK CREEK AT FELTON BRIDGE (WFFELBR)
(μCi/mL)

1988	ALPHA	BETA	H-3	SR-90	CS-137
JAN	<6.9 E-10	3.01 ± 1.2 E-09	<1.0 E-07	2.11 ± 2.1 E-09	<2.1 E-08
FEB	<1.4 E-09	3.87 ± 1.3 E-09	<1.0 E-07	<1.9 E-09	<2.1 E-08
MAR	<1.0 E-09	7.32 ± 1.4 E-09	<1.0 E-07	4.91 ± 2.0 E-09	<2.1 E-08
APR	2.52 ± 1.8 E-09	7.80 ± 1.4 E-09	<1.0 E-07	2.92 ± 1.5 E-09	<2.1 E-08
MAY	1.76 ± 1.4 E-09	4.98 ± 1.2 E-09	<1.3 E-07	3.30 ± 1.3 E-09	<2.1 E-08
JUN	<9.1 E-10	4.24 ± 1.1 E-09	<1.0 E-07	3.48 ± 1.6 E-09	<2.1 E-08
JUL	<8.7 E-10	5.00 ± 1.2 E-09	<1.0 E-07	1.14 ± 1.0 E-09	<2.1 E-08
AUG	<8.2 E-10	3.33 ± 1.0 E-09	<1.0 E-07	1.71 ± 1.2 E-09	<2.1 E-08
SEP	<1.2 E-09	3.73 ± 1.1 E-09	<1.0 E-07	<1.1 E-09	<2.1 E-08
OCT	1.87 ± 1.8 E-09	6.30 ± 1.3 E-09	<1.0 E-07	8.92 ± 2.1 E-09	<2.1 E-08
NOV	<1.1 E-09	2.83 ± 1.0 E-09	<1.0 E-07	3.50 ± 1.6 E-09	<2.1 E-08
DEC	<1.4 E-09	5.14 ± 1.2 E-09	<1.0 E-07	3.86 ± 1.5 E-09	<2.1 E-08

TABLE C-1.6
RADIOACTIVITY CONCENTRATIONS IN POTABLE WELL WATER
AROUND THE WVDP SITE - 1988
(μCi/mL)

Sample I.D.	Alpha	Beta	Tritium	Cs-137
WFWEL 01	<1.1 E-09	1.35 ± 0.97 E-09	<1.0 E-07	<3.7 E-08
WFWEL 03	<1.1 E-09	2.76 ± 1.17 E-09	<1.0 E-07	<3.7 E-08
WFWEL 04	<1.4 E-09	2.09 ± 1.32 E-09	<1.0 E-07	<3.7 E-08
WFWEL 06	<6.4 E-10	<8.0 E-10	<1.0 E-07	<3.7 E-08
WFWEL 07	<9.3 E-10	<8.8 E-10	<1.0 E-07	<3.7 E-08
WFWEL 10	<9.5 E-10	<9.3 E-10	<1.0 E-07	<3.7 E-08

TABLE C-1.7

1988 RADIOACTIVITY CONCENTRATIONS IN STREAM SEDIMENT AROUND WVDP SITE

(µCi/mL, dry weight from upper 15 cm)

Location	Date	K-40	Cs-137
SFBCSED	June 1988	1.24 ± 0.1 E-05	7.72 ± 3.8 E-08
SFSDSED	June 1988	1.28 ± 0.2 E-05	3.79 ± 1.4 E-07
SFTCSED	June 1988	8.91 ± 1.7 E-06	2.68 ± 0.2 E-06
SFCCSED	June 1988	1.25 ± 0.2 E-05	4.67 ± 1.3 E-07
SFBISED	June 1988	1.08 ± 0.1 E-05	5.33 ± 3.7 E-08
SFBCSED	Oct. 1988	1.20 ± 0.1 E-05	4.65 ± 3.9 E-08
SFSDSED	Nov. 1988	1.52 ± 0.2 E-05	7.18 ± 1.5 E-07
SFTCSED	Oct. 1988	1.36 ± 0.2 E-05	1.91 ± 0.2 E-06
SFCCSED	Oct. 1988	1.20 ± 0.2 E-05	4.25 ± 3.8 E-08
SFBISED	Oct. 1988	1.08 ± 0.1 E-05	6.73 ± 3.8 E-08

TABLE C-1.8

1988 CONTRIBUTION BY NEW YORK STATE LOW-LEVEL WASTE DISPOSAL AREA TO RADIOACTIVITY IN WVDP LIQUID EFFLUENTS
(Curies)

	1988 Totals
Gross Alpha	< 5.3 E-07
Gross Beta	6.43 ± 0.3 E-04
Tritium	4.35 ± 0.1 E-02
Sr-90	3.45 ± 0.1 E-04
I-129	7.79 ± 2.7 E-07
Cs-137	3.63 ± 3.0 E-05

APPENDIX C-2
SUMMARY OF AIR MONITORING DATA

TABLE C-2.1.1

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM MAIN VENTILATION STACK (ANSTACK)
(CURIES)

MONTH	ALPHA	BETA	TRITIUM (H-3)
JAN	2.38 ± 0.9 E-07	1.35 ± 0.1 E-05	4.05 ± 0.4 E-02
FEB	1.72 ± 0.7 E-07	1.49 ± 0.1 E-05	2.49 ± 0.3 E-02
MAR	1.99 ± 0.7 E-07	8.88 ± 0.4 E-06	2.13 ± 0.2 E-02
APR	3.59 ± 1.1 E-07	1.03 ± 0.1 E-05	3.16 ± 0.3 E-02
MAY	1.22 ± 0.6 E-07	4.19 ± 0.3 E-06	1.11 ± 0.1 E-02
JUN	4.36 ± 1.2 E-07	1.23 ± 0.1 E-05	7.23 ± 0.8 E-03
JUL	2.56 ± 0.9 E-07	9.80 ± 0.6 E-06	1.63 ± 0.2 E-02
AUG	2.72 ± 0.9 E-07	1.02 ± 0.1 E-05	1.49 ± 0.2 E-02
SEP	1.79 ± 0.7 E-07	7.08 ± 0.7 E-06	1.55 ± 0.2 E-02
OCT	1.84 ± 0.8 E-07	6.54 ± 0.4 E-06	1.43 ± 0.2 E-02
NOV	3.02 ± 0.9 E-07	9.13 ± 0.7 E-06	1.60 ± 0.2 E-02
DEC	3.51 ± 1.1 E-07	8.07 ± 0.6 E-06	2.77 ± 0.3 E-02
TOTAL FOR 1988	3.07 ± 0.3 E-06	1.15 ± 0.03E-04	2.41 ± 0.1 E-01

TABLE C-2.1.2

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM MAIN VENTILATION STACK (ANSTACK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	<9.8 E-08	1.02 ± 0.1 E-05	1.01 ± 0.1 E-05	<8.7 E-08	1.36 ± 0.03 E-05	<2.2 E-07
2ND QTR	7.73 ± 5.6 E-08	6.35 ± 0.7 E-06	1.34 ± 0.1 E-05	<6.6 E-08	1.04 ± 0.02 E-05	<2.1 E-07
3RD QTR	<1.5 E-07	7.37 ± 0.7 E-06	1.73 ± 0.1 E-05	<8.6 E-08	9.30 ± 1.0 E-06	<1.2 E-07
4TH QTR	<1.2 E-07	6.35 ± 0.6 E-06	7.26 ± 0.5 E-06	<9.7 E-08	6.70 ± 0.7 E-06	<1.2 E-07
1988 TOTALS	<2.2 E-07	3.03 ± 0.2 E-05	4.81 ± 0.2 E-05	<1.7 E-07	4.00 ± 0.1 E-05	<3.5 E-07

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	8.40 ± 2.0 E-09	<2.3 E-10	6.81 ± 1.9 E-09	7.14 ± 0.6 E-08	1.01 ± 0.1 E-07	2.19 ± 0.3 E-06
2ND QTR	7.07 ± 1.7 E-09	<1.0 E-10	7.81 ± 1.7 E-09	1.09 ± 0.1 E-07	1.35 ± 0.1 E-07	3.00 ± 0.4 E-07
3RD QTR	<5.1 E-09	<5.1 E-09	6.51 ± 4.0 E-09	7.67 ± 2.3 E-08	9.06 ± 2.8 E-08	2.79 ± 1.9 E-09
4TH QTR	7.53 ± 4.0 E-09	<4.6 E-09	8.56 ± 4.2 E-09	5.51 ± 1.5 E-08	5.70 ± 1.5 E-08	2.91 ± 0.4 E-07
1988 TOTALS	2.81 ± 0.7 E-08	<6.9 E-09	2.97 ± 0.6 E-08	3.12 ± 0.3 E-07	3.84 ± 0.3 E-07	2.78 ± 0.3 E-06

TABLE C-2.1.3

COMPARISON OF 1988 MAIN STACK EXHAUST RADIOACTIVITY CONCENTRATIONS WITH DOE GUIDELINES

ISOTOPE	TOTAL µCi RELEASED[a]	AVG CONC (µCi/mL)	DCG (µCi/mL)	PERCENT OF DCG
Alpha	3.07 E+00	3.4 E-15	NA[b]	--
Beta	1.15 E+02	1.3 E-13	NA[b]	--
H-3	2.41 E+05	2.7 E-04[e]	1 E-07	0.3
Co-60	<2.2 E-01	<2.5 E-16	8 E-11	<0.1
Sr-90	3.03 E+01	3.4 E-14	9 E-12	0.4
I-129	4.81 E+01	5.4 E-14	7 E-11	<0.1
Cs-134	<1.7 E-01	<1.9 E-16	2 E-10	<0.1
Cs-137	4.00 E+01	4.5 E-14	4 E-10	<0.1
Eu-154	<3.5 E-01	<3.9 E-16	5 E-11	<0.1
U-234[c]	2.81 E-02	3.1 E-17	9 E-14	<0.1
U-235[c]	<6.9 E-03	<7.7 E-18	1 E-13	<0.1
U-238[c]	2.97 E-02	3.3 E-17	1 E-13	<0.1
Pu-238	3.12 E-01	3.5 E-16	3 E-14	2.2
Pu-239	3.84 E-01	4.3 E-16	2 E-14	2.2
Am-241	2.78 E+00	3.1 E-15	2 E-14	15.5

				20.9[d]

Notes: [a] Total volume released at 60,000 cfm = 8.95 E+14 mL/yr.

[b] Derived Concentration Guides (DCG) are not specified for gross alpha or beta activity.

[c] Total U µg = 8.58 E+4; Average U pg/mL = 9.59 E-05

[d] Total percent DCG for specific measured radionuclides. The percent DCG at the site boundary location with the highest annual average concentration is only 0.000089.

[e] Tritium reported in pCi/mL.

General: DCGs are listed for reference only. They are applicable to the average concentrations at the site boundary and not to the stack concentrations, as might be inferred from their inclusion in this table.

TABLE C-2.1.4

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM CEMENT SOLIDIFICATION SYSTEM VENTILATION STACK (ANCSSTK)
(CURIES)

MONTH	ALPHA	BETA
JAN	<6.5 E-09	<2.4 E-08
FEB	<4.3 E-09	<1.9 E-08
MAR	<4.6 E-09	<1.8 E-08
APR	<7.1 E-09	3.92 ± 2.3 E-08
MAY	<5.4 E-09	3.85 ± 1.7 E-08
JUN	<5.4 E-09	3.07 ± 1.6 E-08
JUL	<7.8 E-09	2.90 ± 1.9 E-08
AUG	<5.1 E-09	4.06 ± 1.8 E-08
SEP	<5.5 E-09	2.52 ± 1.7 E-08
OCT	<6.4 E-09	6.10 ± 2.3 E-08
NOV	<5.7 E-09	5.81 ± 1.9 E-08
DEC	<8.6 E-09	8.98 ± 2.7 E-08
TOTAL FOR 1988	<2.1 E-08	4.73 ± 0.7 E-07

TABLE C-2.1.5

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM CEMENT SOLIDIFICATION SYSTEM VENTILATION STACK (ANCSSTK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	<2.0 E-08	8.82 ± 2.1 E-09	<6.2 E-09	<1.3 E-08	<1.7 E-08	<5.6 E-08
2ND QTR	<1.4 E-08	<1.7 E-09	<2.5 E-08	<1.3 E-08	<1.5 E-08	<3.1 E-08
3RD QTR	<2.5 E-08	<8.7 E-09	<1.8 E-08	<1.5 E-08	<1.4 E-08	<1.7 E-08
4TH QTR	<3.2 E-08	4.68 ± 0.9 E-09	<1.6 E-08	<2.1 E-08	<2.9 E-08	<1.9 E-08
1988 TOTALS	<4.7 E-08	2.24 ± 0.9 E-08	<3.5 E-08	<3.2 E-08	<3.9 E-08	<6.9 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	2.07 ± 0.4 E-09	<1.5 E-10	1.39 ± 0.3 E-09	<4.1 E-11	1.22 ± 1.2 E-10	<1.1 E-09
2ND QTR	1.65 ± 0.4 E-09	<8.6 E-11	1.88 ± 0.4 E-09	<7.9 E-11	<6.2 E-11	<1.4 E-11
3RD QTR	2.36 ± 1.1 E-09	<1.2 E-09	1.63 ± 1.0 E-09	<2.9 E-10	<2.9 E-10	<6.7 E-10
4TH QTR	1.59 ± 0.9 E-09	<1.1 E-09	1.59 ± 0.9 E-09	<2.4 E-10	<2.4 E-10	<1.1 E-09
1988 TOTALS	7.67 ± 1.5 E-09	<1.6 E-09	6.49 ± 1.4 E-09	<3.9 E-10	<4.0 E-10	<1.7 E-09

TABLE C-2.1.6

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM CONTACT SIZE REDUCTION FACILITY VENTILATION STACK (ANCSRFK)
(CURIES)

MONTH	ALPHA	BETA
JAN	<3.9 E-09	<1.5 E-08
FEB	<3.0 E-09	<1.2 E-08
MAR	<4.1 E-09	1.38 ± 1.3 E-08
APR	<4.3 E-09	5.95 ± 1.8 E-08
MAY	<4.2 E-09	5.13 ± 1.4 E-08
JUN	<3.8 E-09	4.91 ± 1.4 E-08
JUL	<4.3 E-09	7.77 ± 1.9 E-08
AUG	<2.9 E-09	4.36 ± 1.5 E-08
SEP	<4.0 E-09	3.56 ± 1.3 E-08
OCT	<5.5 E-09	6.25 ± 1.7 E-08
NOV	<3.8 E-09	5.44 ± 1.4 E-08
DEC	<5.1 E-09	7.55 ± 1.8 E-08
TOTAL FOR 1988	<1.4 E-08	5.50 ± 0.5 E-07

TABLE C-2.1.7

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM CONTACT SIZE REDUCTION FACILITY VENTILATION STACK (ANCSRFK)
(CURIES)

	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR	<7.9 E-09	<2.0 E-09	<4.5 E-09	<5.9 E-09	<7.7 E-09	<2.0 E-08
2ND QTR	<9.2 E-09	<1.1 E-09	<1.5 E-08	<6.6 E-09	<7.7 E-09	<2.5 E-08
3RD QTR	<1.1 E-08	<2.1 E-09	<7.6 E-09	<8.5 E-09	<7.6 E-09	<7.5 E-09
4TH QTR	<1.4 E-08	<5.8 E-10	<7.7 E-09	<1.1 E-08	<1.2 E-08	<8.9 E-09
1988 TOTALS	<2.2 E-08	<3.2 E-09	<1.9 E-08	<1.6 E-08	<1.8 E-08	<3.4 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR	7.19 ± 1.7 E-10	<3.1 E-11	6.34 ± 1.6 E-10	<2.0 E-11	<9.8 E-12	<2.8 E-10
2ND QTR	6.23 ± 1.8 E-10	1.01 ± 1.0 E-10	7.79 ± 1.8 E-10	<1.2 E-11	5.35 ± 4.7 E-11	1.00 ± 0.7 E-10
3RD QTR	1.19 ± 0.5 E-09	<5.4 E-10	6.23 ± 4.2 E-10	<1.6 E-10	<1.6 E-10	<2.5 E-10
4TH QTR	1.16 ± 0.6 E-09	<6.4 E-10	<6.4 E-10	<1.5 E-10	<1.5 E-10	<6.1 E-10
1988 TOTALS	3.69 ± 0.8 E-09	<8.4 E-10	2.68 ± 0.8 E-09	<2.2 E-10	<2.2 E-10	<7.2 E-10

TABLE C-2.1.8

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM SUPERNATANT TREATMENT SYSTEM VENTILATION STACK (ANSTSTK)
(CURIES)

MONTH	ALPHA	BETA
JAN	***NOT IN OPERATION***	
FEB	***NOT IN OPERATION***	
MAR	***NOT IN OPERATION***	
APR	***NOT IN OPERATION***	
MAY	<1.0 E-09	5.86 ± 2.6 E-09
JUN	<7.0 E-09	5.39 ± 1.8 E-08
JUL	<2.5 E-09	2.64 ± 0.9 E-08
AUG	<2.0 E-09	1.06 ± 0.6 E-08
SEP	<2.2 E-09	6.21 ± 5.5 E-09
OCT	<2.1 E-09	1.02 ± 0.6 E-08
NOV	<1.3 E-09	7.29 ± 5.1 E-09
DEC	<2.2 E-09	1.01 ± 0.7 E-08
TOTAL FOR 1988	<8.7 E-09	1.31 ± 0.2 E-07

TABLE C-2.1.9

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM SUPERNATANT TREATMENT SYSTEM VENTILATION SYSTEM (ANSTSTK)
(CURIES)

	H-3*	CO-60	SR-90	I-129	CS-134	CS-137	EU-154
1ST QTR				***NOT IN OPERATION***			
2ND QTR	<1.3 E-02	<5.2 E-09	<6.8 E-10	2.80 ± 0.3 E-07	<3.6 E-09	<3.6 E-09	<9.0 E-09
3RD QTR	ND	<7.2 E-09	<1.5 E-09	1.52 ± 0.1 E-07	<4.6 E-09	<4.1 E-09	<4.4 E-09
4TH QTR	ND	<8.3 E-09	<5.9 E-10	2.66 ± 0.2 E-07	<6.7 E-09	<7.2 E-09	<5.7 E-09
1988 TOTALS	<1.3 E-02	<1.2 E-08	<1.7 E-09	6.98 ± 0.4 E-07	<8.9 E-09	<9.0 E-09	<1.2 E-08

	U-234	U-235	U-238	PU-238	PU-239	AM-241
1ST QTR			***NOT IN OPERATION***			
2ND QTR	3.21 ± 1.0 E-10	<5.2 E-11	3.75 ± 1.0 E-10	<5.6 E-12	<3.2 E-11	<3.7 E-12
3RD QTR	4.75 ± 2.9 E-10	<3.7 E-10	6.62 ± 3.4 E-10	8.49 ± 5.8 E-11	<6.6 E-11	<8.8 E-10
4TH QTR	5.18 ± 2.8 E-10	<3.1 E-10	3.43 ± 2.3 E-10	<7.0 E-11	<7.0 E-11	1.92 ± 0.5 E-09
1988 TOTALS	1.31 ± 0.4 E-09	<4.9 E-10	1.38 ± 0.4 E-09	1.55 ± 0.9 E-10	<1.0 E-10	2.80 ± 1.0 E-09

ND - No Discharge detectable. Due to dry exhaust air conditions, no moisture could be collected for H-3 analysis.

TABLE C-2.1.10

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY MONTHLY TOTALS
FROM SUPERCOMPACTOR VENTILATION STACK (ANSUPCV)
(CURIES)

MONTH	ALPHA	BETA
JAN	6.93 ± 1.8 E-10	3.38 ± 0.2 E-08
FEB	4.10 ± 1.7 E-10	4.33 ± 0.2 E-08
MAR	4.37 ± 1.8 E-10	4.62 ± 0.2 E-08
APR	3.05 ± 2.0 E-10	2.80 ± 0.2 E-08
MAY	<1.5 E-10	2.78 ± 0.5 E-09
JUN	<1.0 E-10	1.14 ± 0.4 E-09
JUL	<1.6 E-10	1.82 ± 0.5 E-09
AUG	4.55 ± 2.7 E-10	7.92 ± 0.9 E-09
SEP	5.89 ± 2.6 E-10	6.54 ± 0.7 E-09
OCT	2.97 ± 2.4 E-10	1.36 ± 0.5 E-09
NOV	<9.9 E-11	7.10 ± 3.3 E-10
DEC	<9.8 E-11	1.61 ± 0.5 E-09
TOTAL FOR 1988	3.79 ± 0.6 E-09	1.75 ± 0.1 E-07

TABLE C-2.1.11

1988 AIRBORNE RADIOACTIVE EFFLUENT ACTIVITY QUARTERLY TOTALS
FROM SUPERCOMPACTOR VENTILATION SYSTEM (ANSUPCV)
(CURIES)

	Co-60	Sr-90	Cs-134	Cs-137	Eu-154
1ST QTR			***DATA NOT AVAILABLE***		
2ND QTR	5.27 ± 1.7 E-09	3.12 ± 1.4 E-10	<1.3 E-09	2.28 ± 0.2 E-08	<4.3 E-09
3RD QTR	<2.6 E-09	<6.2 E-10	<1.3 E-09	4.72 ± 1.4 E-09	<1.3 E-09
4TH QTR	<2.4 E-09	<9.2 E-11	<1.5 E-09	<2.2 E-09	<1.5 E-09
1988 TOTALS	8.77 ± 3.9 E-09	9.39 ± 6.4 E-10	<2.4 E-09	2.97 ± 0.3 E-08	<4.7 E-09

	U-234	U-235	U-238	Pu-238	Pu-239	Am-241
1ST QTR			***DATA NOT AVAILABLE***			
2ND QTR	<3.3 E-11	<5.1 E-12	<2.5 E-11	3.48 ± 1.7 E-11	1.65 ± 0.4 E-10	1.98 ± 0.3 E-10
3RD QTR	<1.1 E-10	<1.1 E-10	<1.1 E-10	<2.2 E-11	2.59 ± 1.9 E-11	<8.5 E-11
4TH QTR	<9.6 E-11	<9.6 E-11	<9.6 E-11	<2.3 E-11	<2.3 E-11	<1.1 E-10
1988 TOTALS	<1.5 E-10	<1.5 E-10	<1.5 E-10	6.66 ± 3.6 E-11	2.14 ± 0.5 E-11	3.37 ± 1.4 E-10

TABLE C-2.2.1

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT FOX VALLEY AIR SAMPLER (AFFXVRD)

μCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	9.55 ± 8.9 E-16	1.75 ± 0.4 E-14		
FEB	<9.1 E-16	1.65 ± 0.4 E-14		
MAR	9.63 ± 9.5 E-16	1.00 ± 0.3 E-14		
1ST QTR			<6.5 E-17	<5.8 E-16
APR	1.03 ± 0.9 E-15	1.70 ± 0.4 E-14		
MAY	7.96 ± 7.9 E-16	1.46 ± 0.3 E-14		
JUNE	8.95 ± 7.4 E-16	1.77 ± 0.3 E-14		
2ND QTR			3.95 ± 2.5 E-17	<5.7 E-16
JUL	7.99 ± 7.1 E-16	1.99 ± 0.3 E-14		
AUG	6.93 ± 6.6 E-16	1.93 ± 0.3 E-14		
SEP	8.16 ± 7.1 E-16	1.45 ± 0.3 E-14		
3RD QTR			<1.9 E-16	<4.9 E-16
OCT	<5.4 E-16	1.28 ± 0.3 E-14		
NOV	9.26 ± 7.4 E-16	2.07 ± 0.3 E-14		
DEC	9.91 ± 7.7 E-16	2.70 ± 0.3 E-14		
4TH QTR			<6.4 E-17	<3.7 E-16

TABLE C-2.2.2

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT ROCK SPRINGS ROAD AIR SAMPLER (AFRSPRD)

μCi/mL

	ALPHA	BETA	SR-90	I-129	CS-137
JAN	1.16 ± 0.9 E-15	2.00 ± 0.4 E-14			
FEB	<8.5 E-16	1.88 ± 0.4 E-14			
MAR	<7.8 E-16	1.24 ± 0.3 E-14			
1ST QTR			<5.8 E-17	<4.7 E-16	<3.8 E-16
APR	<6.3 E-16	1.89 ± 0.3 E-14			
MAY	<7.4 E-16	1.84 ± 0.3 E-14			
JUNE	1.16 ± 1.1 E-15	2.50 ± 0.4 E-14			
2ND QTR			<4.2 E-17	<9.8 E-16	<6.1 E-16
JUL	1.13 ± 0.9 E-15	2.64 ± 0.4 E-14			
AUG	1.25 ± 1.2 E-15	2.94 ± 0.5 E-14			
SEP	1.77 ± 1.5 E-15	2.73 ± 0.5 E-14			
3RD QTR			<2.7 E-16	<5.5 E-16	<5.7 E-16
OCT	<2.0 E-15	4.19 ± 0.8 E-14			
NOV	8.09 ± 7.9 E-16	2.55 ± 0.4 E-14			
DEC	1.14 ± 0.8 E-15	2.92 ± 0.4 E-14			
4TH QTR			<7.1 E-17	<3.3 E-16	<6.7 E-16

TABLE C-2.2.3

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT ROUTE 240 AIR SAMPLER (AFRT240)

µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	<9.1 E-16	1.76 ± 0.4 E-14		
FEB	<7.4 E-16	1.74 ± 0.4 E-14		
MAR	9.66 ± 9.5 E-16	1.11 ± 0.4 E-14		
1ST QTR			<6.8 E-17	<6.2 E-16
APR	<7.3 E-16	2.13 ± 0.4 E-14		
MAY	<8.2 E-16	1.82 ± 0.4 E-14		
JUNE	<9.5 E-16	1.76 ± 0.4 E-14		
2ND QTR			<4.6 E-17	<5.4 E-16
JUL	1.14 ± 1.0 E-15	2.23 ± 0.4 E-14		
AUG	<9.0 E-16	2.04 ± 0.4 E-14		
SEP	<2.5 E-15	2.26 ± 1.0 E-14		
3RD QTR			<2.6 E-16	<5.5 E-16
OCT	<7.4 E-16	1.49 ± 0.3 E-14		
NOV	7.28 ± 7.1 E-16	2.37 ± 0.4 E-14		
DEC	9.76 ± 8.2 E-16	2.92 ± 0.4 E-14		
4TH QTR			<6.0 E-17	<5.6 E-16

TABLE C-2.2.4

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT SPRINGVILLE AIR SAMPLER (AFSPRVL)

µCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	<7.3 E-16	1.98 ± 0.4 E-14		
FEB	1.05 ± 0.9 E-15	2.17 ± 0.4 E-14		
MAR	7.22 ± 5.9 E-16	1.06 ± 0.3 E-14		
1ST QTR			<7.6 E-17	<5.9 E-16
APR	9.98 ± 8.2 E-16	2.06 ± 0.3 E-14		
MAY	<6.8 E-16	1.58 ± 0.3 E-14		
JUNE	1.16 ± 0.9 E-15	2.05 ± 0.3 E-14		
2ND QTR			5.19 ± 2.4 E-17	<5.0 E-16
JUL	8.95 ± 7.4 E-16	1.93 ± 0.3 E-14		
AUG	9.94 ± 7.6 E-16	1.79 ± 0.3 E-14		
SEP	<7.3 E-16	1.66 ± 0.3 E-14		
3RD QTR			<1.7 E-16	<4.9 E-16
OCT	7.70 ± 7.7 E-16	1.75 ± 0.3 E-14		
NOV	1.12 ± 0.8 E-15	2.46 ± 0.4 E-14		
DEC	1.79 ± 1.1 E-15	3.41 ± 0.4 E-14		
4TH QTR			<4.4 E-17	<4.7 E-16

TABLE C-2.2.5

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT THOMAS CORNERS AIR SAMPLER (AFTCORD)

μCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	1.10 ± 0.9 E-15	1.90 ± 0.4 E-14		
FEB	<8.0 E-16	1.73 ± 0.4 E-14		
MAR	<7.3 E-16	1.11 ± 0.3 E-14		
1ST QTR			<8.1 E-17	<4.7 E-16
APR	1.20 ± 1.1 E-15	2.04 ± 0.4 E-14		
MAY	1.26 ± 1.0 E-15	1.79 ± 0.4 E-14		
JUNE	1.13 ± 0.8 E-15	1.83 ± 0.3 E-14		
2ND QTR			<3.8 E-17	<5.4 E-16
JUL	1.14 ± 0.8 E-15	1.90 ± 0.3 E-14		
AUG	8.78 ± 7.9 E-16	1.55 ± 0.3 E-14		
SEP	<7.4 E-16	1.42 ± 0.3 E-14		
3RD QTR			<3.3 E-16	<4.5 E-16
OCT	<8.0 E-16	1.36 ± 0.3 E-14		
NOV	6.28 ± 5.6 E-16	2.30 ± 0.3 E-14		
DEC	9.99 ± 7.0 E-16	2.54 ± 0.3 E-14		
4TH QTR			<4.8 E-17	<4.7 E-16

TABLE C-2.2.6

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT WEST VALLEY AIR SAMPLER (AFWEVAL)

μCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	<7.3 E-16	1.99 ± 0.3 E-14		
FEB	8.45 ± 7.8 E-16	1.71 ± 0.3 E-14		
MAR	1.05 ± 0.8 E-15	1.26 ± 0.3 E-14		
1ST QTR			<7.0 E-17	<3.8 E-16
APR	<5.4 E-16	1.81 ± 0.3 E-14		
MAY	1.07 ± 0.8 E-15	1.55 ± 0.3 E-14		
JUNE	1.26 ± 0.9 E-15	1.89 ± 0.3 E-14		
2ND QTR			4.05 ± 2.0 E-17	<4.1 E-16
JUL	8.52 ± 7.6 E-16	2.21 ± 0.3 E-14		
AUG	8.49 ± 6.9 E-16	2.10 ± 0.3 E-14		
SEP	<6.2 E-16	1.63 ± 0.3 E-14		
3RD QTR			<1.8 E-16	<4.7 E-16
OCT	6.89 ± 6.8 E-16	1.63 ± 0.3 E-14		
NOV	1.29 ± 0.8 E-15	2.29 ± 0.3 E-14		
DEC	9.09 ± 7.5 E-16	2.87 ± 0.4 E-14		
4TH QTR			<3.9 E-17	<6.1 E-16

TABLE C-2.2.7

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT GREAT VALLEY AIR SAMPLER (AFGRVAL)

μCi/mL

	ALPHA	BETA	SR-90	I-129	CS-137
JAN	1.16 ± 1.0 E-15	2.35 ± 0.4 E-14			
FEB	1.40 ± 1.2 E-15	2.17 ± 0.4 E-14			
MAR	<7.3 E-16	1.58 ± 0.4 E-14			
1ST QTR			7.96 ± 3.9 E-17	<4.4 E-16	<4.0 E-16
APR	1.01 ± 0.8 E-15	2.00 ± 0.3 E-14			
MAY	1.09 ± 0.9 E-15	2.00 ± 0.3 E-14			
JUNE	1.03 ± 0.9 E-15	2.06 ± 0.3 E-14			
2ND QTR			<3.5 E-17	<7.0 E-17	<6.0 E-16
JUL	8.61 ± 6.9 E-16	2.02 ± 0.3 E-14			
AUG	8.27 ± 7.0 E-16	2.19 ± 0.3 E-14			
SEP	6.40 ± 6.2 E-16	1.70 ± 0.3 E-14			
3RD QTR			<2.0 E-16	<3.5 E-16	<5.0 E-16
OCT	7.85 ± 6.7 E-16	1.77 ± 0.3 E-14			
NOV	9.49 ± 7.4 E-16	2.16 ± 0.3 E-14			
DEC	1.79 ± 1.0 E-15	2.85 ± 0.4 E-14			
4TH QTR			<4.4 E-17	<3.8 E-16	<5.8 E-16

TABLE C-2.2.8

1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE

AT DUNKIRK AIR SAMPLER (AFDNKRK)

μCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	<7.1 E-16	1.43 ± 0.3 E-14		
FEB	9.15 ± 7.7 E-16	1.56 ± 0.3 E-14		
MAR	7.03 ± 6.4 E-16	8.93 ± 2.6 E-15		
1ST QTR			1.28 ± 0.3 E-16	<4.0 E-16
APR	5.84 ± 5.8 E-16	1.56 ± 0.3 E-14		
MAY	7.08 ± 6.6 E-16	1.39 ± 0.3 E-14		
JUNE	1.09 ± 7.9 E-15	1.61 ± 0.3 E-14		
2ND QTR			<3.9 E-17	<4.8 E-16
JUL	1.82 ± 1.1 E-15	2.42 ± 0.4 E-14		
AUG	1.12 ± 0.9 E-15	2.66 ± 0.4 E-14		
SEP	<7.9 E-16	2.19 ± 0.4 E-14		
3RD QTR			<2.0 E-16	<5.7 E-16
OCT	1.07 ± 0.9 E-15	2.21 ± 0.4 E-14		
NOV	1.13 ± 0.7 E-15	2.55 ± 0.4 E-14		
DEC	1.82 ± 1.1 E-15	3.41 ± 0.4 E-14		
4TH QTR			4.89 ± 2.9 E-17	<8.2 E-16

TABLE C-2.2.9
1988 RADIOACTIVITY CONCENTRATIONS IN AIRBORNE PARTICULATE
AT DUTCH HILL AIR SAMPLER (AFBOEHN)
μCi/mL

	ALPHA	BETA	SR-90	CS-137
JAN	<8.0 E-16	1.55 ± 0.3 E-14		
FEB	7.62 ± 6.9 E-16	1.51 ± 0.3 E-14		
MAR	8.86 ± 6.7 E-16	9.06 ± 2.4 E-15		
1ST QTR			<4.8 E-17	<4.1 E-16
APR	<5.5 E-16	1.41 ± 0.3 E-14		
MAY	9.14 ± 6.8 E-16	1.24 ± 0.2 E-14		
JUNE	1.07 ± 1.0 E-15	1.97 ± 0.4 E-14		
2ND QTR			<3.1 E-17	<4.6 E-16
JUL	<2.4 E-15	2.82 ± 0.8 E-14		
AUG	<1.8 E-15	2.50 ± 0.7 E-14		
SEP	<6.5 E-16	1.47 ± 0.3 E-14		
3RD QTR			<4.0 E-16	<3.1 E-16
OCT	<8.5 E-16	1.61 ± 0.3 E-14		
NOV	1.13 ± 0.8 E-15	2.30 ± 0.4 E-14		
DEC	1.03 ± 0.7 E-15	2.53 ± 0.3 E-14		
4TH QTR			<4.3 E-17	<7.4 E-16

TABLE C-2.3.1

RADIOACTIVITY IN FALLOUT DURING 1988
($nCi/m^2/mo$)

DUTCH HILL (AFDHFOP)

MONTH - 1988	GROSS ALPHA	GROSS BETA	H-3 ($\mu Ci/mL$)
JANUARY	9.5 E-03	8.0 E-02	<1.0 E-07
FEBRUARY	2.4 E-02	1.3 E-01	<1.0 E-07
MARCH	5.4 E-02	3.5 E-01	<1.0 E-07
APRIL	4.8 E-02	4.9 E-01	<1.0 E-07
MAY	5.4 E-02	3.7 E-01	1.55 ± 1.2 E-07
JUNE	8.1 E-02	3.0 E-01	Sample Dry
JULY	6.7 E-02	4.2 E-01	<1.0 E-07
AUGUST	4.1 E-02	3.8 E-01	<1.0 E-07
SEPTEMBER	6.0 E-02	3.9 E-01	<1.0 E-07
OCTOBER	5.7 E-02	3.7 E-01	<1.0 E-07
NOVEMBER	4.3 E-02	2.8 E-01	<1.0 E-07
DECEMBER	3.9 E-02	2.6 E-01	<1.0 E-07

FOX VALLEY ROAD (AFFXFOP)

MONTH - 1988	GROSS ALPHA	GROSS BETA	H-3 ($\mu Ci/mL$)
JANUARY	4.7 E-02	1.9 E-01	<1.0 E-07
FEBRUARY	3.9 E-02	2.1 E-01	2.07 ± 1.1 E-07
MARCH	9.7 E-02	4.5 E-01	2.87 ± 1.3 E-07
APRIL	5.0 E-02	4.5 E-01	2.91 ± 1.3 E-07
MAY	6.7 E-02	4.5 E-01	1.25 ± 1.2 E-07
JUNE	3.2 E-02	2.6 E-01	Sample Dry
JULY	6.2 E-02	4.8 E-01	<1.0 E-07
AUGUST	5.5 E-02	4.9 E-01	<1.0 E-07
SEPTEMBER	7.0 E-02	3.3 E-01	<1.0 E-07
OCTOBER	5.0 E-02	5.4 E-01	2.16 ± 1.4 E-07
NOVEMBER	5.3 E-02	4.2 E-01	<1.0 E-07
DECEMBER	4.5 E-02	4.8 E-01	<1.0 E-07

ROUTE 240 (AF24FOP)

MONTH - 1988	GROSS ALPHA	GROSS BETA	H-3 ($\mu Ci/mL$)
JANUARY	2.1 E-02	1.3 E-01	<1.0 E-07
FEBRUARY	2.1 E-02	1.5 E-01	2.23 ± 1.1 E-07
MARCH	6.1 E-02	4.1 E-01	2.40 ± 1.2 E-07
APRIL	5.9 E-02	4.7 E-01	2.35 ± 1.3 E-07
MAY	5.8 E-02	4.6 E-01	<1.0 E-07
JUNE	4.6 E-02	2.3 E-01	Sample Dry
JULY	4.6 E-02	4.9 E-01	<1.0 E-07
AUGUST	5.6 E-02	5.7 E-01	<1.0 E-07
SEPTEMBER	8.7 E-02	5.9 E-01	<1.0 E-07
OCTOBER	3.2 E-02	5.7 E-01	<1.0 E-07
NOVEMBER	3.0 E-02	3.8 E-01	<1.0 E-07
DECEMBER	3.7 E-02	3.7 E-01	<1.0 E-07

THOMAS CORNERS ROAD (AFTCFOP)

MONTH - 1988	GROSS ALPHA	GROSS BETA	H-3 ($\mu Ci/mL$)
JANUARY	3.5 E-02	1.4 E-01	<1.0 E-07
FEBRUARY	3.9 E-02	2.2 E-01	1.42 ± 1.1 E-07
MARCH	7.2 E-02	4.0 E-01	1.00 ± 0.1 E-06
APRIL	3.6 E-02	4.7 E-01	2.11 ± 1.3 E-07
MAY	1.0 E-01	3.9 E-01	<1.0 E-07
JUNE	1.3 E-01	3.7 E-01	Sample Dry
JULY	1.1 E-01	5.9 E-01	<1.0 E-07
AUGUST	6.3 E-02	4.7 E-01	<1.0 E-07
SEPTEMBER	5.1 E-02	4.5 E-01	<1.0 E-07
OCTOBER	4.5 E-02	5.5 E-01	1.50 ± 1.2 E-07
NOVEMBER	4.4 E-02	5.2 E-01	<1.0 E-07
DECEMBER	5.8 E-02	5.4 E-01	<1.0 E-07

Note: Gross alpha uncertainty is ± 45 %; gross beta uncertainty is ± 20 %.

TABLE C-2.3.2

pH OF PRECIPITATION COLLECTED IN FALLOUT POTS

MONTH - 1988	DUTCH HILL (AFDHFOP)	FOX VALLEY ROAD (AFFXFOP)	ROUTE 240 (AF24FOP)	THOMAS CORNERS ROAD (AFTCFOP)
JANUARY	3.72	4.65	3.58	3.89
FEBRUARY	4.08	4.48	4.21	4.18
MARCH	4.04	5.25	4.24	5.02
APRIL	4.04	5.72	6.10	4.82
MAY	4.18	6.51	7.11	7.04
JUNE	DRY	DRY	DRY	DRY
JULY	4.60	3.98	4.30	4.08
AUGUST	4.41	4.20	4.04	4.11
SEPTEMBER	5.96	4.25	4.26	4.36
OCTOBER	4.30	4.70	4.49	4.30
NOVEMBER	4.01	4.22	3.89	4.12
DECEMBER	4.03	4.34	4.02	4.21

APPENDIX C-3
SUMMARY OF BIOLOGICAL SAMPLE DATA

TABLE C-3.1
RADIOACTIVITY CONCENTRATIONS IN MILK - 1988
(μCi/mL)

LOCATION	H-3	Sr-90	I-129	Cs-134	Cs-137
NNW Farm (BFMREED) 1st Qtr 1988	<2.0 E-07	1.53 ± 0.3 E-09	<3.0 E-10	<1.0 E-08	<1.1 E-08
WNW Farm (BFMCOBO) 1st Qtr 1988	<2.0 E-07	1.82 ± 0.3 E-09	<3.0 E-10	<1.4 E-08	<1.4 E-08
Control (BFMCTLS) 1st Qtr 1988	<2.0 E-07	1.74 ± 0.2 E-09	<3.0 E-10	<1.2 E-08	<1.3 E-08
Control (BFMCTLN) 1st Qtr 1988	<2.0 E-07	2.03 ± 0.3 E-09	<3.0 E-10	<1.1 E-08	<1.0 E-08
NNW Farm (BFMREED) 2nd Qtr 1988	<3.0 E-07	2.48 ± 0.3 E-09	<7.0 E-10	<1.3 E-08	<1.1 E-08
WNW Farm (BFMCOBO) 2nd Qtr 1988	<3.0 E-07	1.94 ± 0.3 E-09	<5.0 E-10	<1.6 E-08	<1.5 E-08
Control (BFMCTLS) 2nd Qtr 1988	<3.0 E-07	1.39 ± 0.2 E-09	<7.0 E-10	<1.5 E-08	<1.2 E-08
Control (BFMCTLN) 2nd Qtr 1988	<3.0 E-07	1.84 ± 0.3 E-09	<6.0 E-10	<1.8 E-08	<1.5 E-08
NNW Farm (BFMREED) 3rd Qtr 1988	<3.5 E-07	4.18 ± 0.3 E-09	<8.9 E-10	<8.7 E-09	<1.3 E-08
WNW Farm (BFMCOBO) 3rd Qtr 1988	<3.5 E-07	4.08 ± 0.3 E-09	<8.9 E-10	<8.8 E-09	<8.9 E-09
Control (BFMCTLS) 3rd Qtr 1988	<3.5 E-07	2.39 ± 0.2 E-09	<8.9 E-10	<7.4 E-09	<9.4 E-09
Control (BFMCTLN) 3rd Qtr 1988	<3.5 E-07	3.33 ± 0.3 E-09	<8.9 E-10	<9.3 E-09	<9.6 E-09
NNW Farm (BFMREED) 4th Qtr 1988	<1.8 E-07	6.47 ± 2.2 E-09	<8.2 E-10	<4.4 E-09	<4.7 E-09
WNW Farm (BFMCOBO) 4th Qtr 1988	<1.8 E-07	<5.5 E-09	<7.7 E-10	<5.6 E-09	<4.6 E-09
Control (BFMCTLS) 4th Qtr 1988	<1.8 E-07	3.41 ± 0.6 E-09	<7.7 E-10	<5.5 E-09	<5.6 E-09
Control (BFMCTLN) 4th Qtr 1988	<1.8 E-07	<2.0 E-09	<4.0 E-09	<4.8 E-09	<4.9 E-09
SE Farm (BFMWIDR) December 1988	<1.8 E-07	<3.9 E-09	<7.7 E-10	<5.0 E-09	<6.0 E-09
SSW Farm (BFMHAUR) December 1988	<1.8 E-07	<2.0 E-09	<2.0 E-09	<5.9 E-09	<6.5 E-09

TABLE C-3.2
RADIOACTIVITY CONCENTRATIONS IN MEAT - 1988
(µCi/g)

LOCATION	Percent Moisture	Sr-90	Cs-134	Cs-137
Deer Flesh - Near Site (BFDNEAR #1) 12/88	69.9	5.60 ± 1.5 E-09	<2.1 E-08	<2.9 E-08
Deer Flesh - Near Site (BFDNEAR #2) 12/88	66.4	1.06 ± 0.2 E-08	<1.9 E-08	4.76 ± 1.9 E-08
Deer Flesh - Nearsite (BFDNEAR #3) 12/88	67.1	3.52 ± 1.3 E-09	<2.0 E-08	6.92 ± 2.0 E-08
Deer Flesh - Background (BFDCTRL #1) 11/88	72.4	2.67 ± 1.1 E-09	<1.9 E-08	1.34 ± 0.1 E-07
Deer Flesh - Background (BFDCTRL #2) 11/88	67.9	7.45 ± 1.6 E-09	<1.7 E-08	8.24 ± 1.1 E-08
Deer Flesh - Background (BFDCTRL #3) 11/88	69.9	<2.1 E-09	<4.6 E-08	1.11 ± 0.5 E-07
Beef Flesh - Near Site (BFBNEAR) 6/88	75.0	<3.7 E-09	<2.6 E-08	<1.4 E-08
Beef Flesh - Background (BFBCTRL) 6/88	74.6	<3.5 E-09	<1.9 E-08	<1.6 E-08
Beef Flesh - Near Site (BFBNEAR) 11/88	68.9	1.82 ± 0.4 E-08	<1.6 E-08	<2.2 E-08
Beef Flesh - Background (BFBCTRL) 10/88	70.6	<4.2 E-09	<2.1 E-08	<2.0 E-08

TABLE C-3.3

RADIOACTIVITY CONCENTRATIONS IN FOOD CROPS - 1988
(μCi/g DRY)

LOCATION	Percent Moisture	Tritium (μCi/mL)	Sr-90	K-40	Co-60	Cs-137
Corn - Near Site (BFVNEAR) 8/88	59.1	1.36 ± 0.2 E-05	<9.6 E-09	5.93 ± 0.8 E-06	<2.9 E-08	<2.2 E-08
Corn - Background (BFVCTRL) 8/88	77.9	1.09 ± 0.2 E-05	<2.1 E-08	1.49 ± 0.2 E-05	<5.3 E-08	<3.6 E-08
Tomatoes - Near Site (BFVNEAR) 8/88	95.2	2.73 ± 0.5 E-06	<3.4 E-08	5.59 ± 0.7 E-05	<2.2 E-07	<1.5 E-07
Tomatoes - Background (BFVCTRL) 8/88	94.8	2.88 ± 0.5 E-06	3.40 ± 1.8 E-08	4.88 ± 0.6 E-05	<2.1 E-07	<1.1 E-07
Apples - Near Site (BFVNEAR) 10/88	84.8	6.93 ± 1.0 E-06	9.26 ± 1.8 E-08	9.30 ± 2.3 E-06	<1.3 E-07	<1.1 E-07
Apples - Background (BFVCTRL) 10/88	86.8	5.85 ± 0.9 E-06	<1.7 E-08	7.60 ± 2.2 E-06	<1.7 E-07	<1.3 E-07
Hay - Near Site (BFVNEAR) 12/88	43.4	NA	1.04 ± 0.2 E-07	1.71 ± 0.3 E-05	<1.2 E-07	<9.8 E-08
Hay - Background (BFVCTRL) 12/88	57.9	NA	1.46 ± 0.2 E-07	2.65 ± 0.4 E-05	<1.5 E-07	<1.0 E-07

NA - Not Analyzed

TABLE C-3.4

RADIOACTIVITY CONCENTRATIONS IN FISH FROM CATTARAUGUS CREEK - 1988

(µCi/g - DRY)

	CATTARAUGUS CREEK (BFFCATC) 2ND QUARTER 1988 FLESH			CATTARAUGUS CREEK (BFFCATC) 3RD QUARTER 1988 FLESH		
	Sr-90	Cs-134	Cs-137	Sr-90	Cs-134	Cs-137
MEDIAN	3.75 E-08	<3.30 E-07	<2.63 E-07	8.41 E-08	<1.80 E-07	<2.23 E-07
AVERAGE GEOMETRIC DEVIATION	1.42	1.79	1.65	1.34	1.28	1.38
MAXIMUM	5.55 E-08	<4.5 E-07	<3.4 E-07	1.29 E-07	<2.5 E-07	4.19 E-07
MINIMUM	<2.0 E-08	<8.9 E-08	<8.2 E-08	6.81 E-08	<1.4 E-07	<1.7 E-07
Average % Moisture	75.0			78.7		

	CATTARAUGUS CREEK (BFFCTRL) BACKGROUND 2ND QTR 1988 FLESH			CATTARAUGUS CREEK (BFFCTRL) BACKGROUND 3RD QTR 1988 FLESH		
	Sr-90	Cs-134	Cs-137	Sr-90	Cs-134	Cs-137
MEDIAN	<1.67 E-08	<4.10 E-07	<3.11 E-07	4.55 E-08	<6.80 E-08	<7.10 E-08
AVG GEOMETRIC DEVIATION	1.65	1.29	1.36	2.47	1.18	1.23
MAXIMUM	<3.0 E-08	<5.5 E-07	<4.1 E-07	9.00 E-08	<7.7 E-07	<7.9 E-08
MINIMUM	<1.0 E-08	<2.9 E-07	<2.1 E-07	<1.0 E-08	<4.8 E-08	<4.6 E-08
Average % Moisture	71.2			76.2		

	CATTARAUGUS CREEK (BFFCATD) BELOW SPRINGVILLE DAM 2ND QTR 1988 FLESH			CATTARAUGUS CREEK (BFFCATD) BELOW SPRINGVILLE DAM 3RD QTR 1988 FLESH		
	Sr-90	Cs-134	Cs-137	Sr-90	Cs-134	Cs-137
MEDIAN	8.05 E-08	<1.28 E-07	<1.29 E-07	2.50 E-08	<5.90 E-08	<6.55 E-08
AVG GEOMETRIC DEVIATION	2.83	1.39	1.49	3.30	1.25	1.33
MAXIMUM	3.01 E-07	<4.0 E-07	<3.2 E-07	8.79 E-08	<7.6 E-08	<8.0 E-08
MINIMUM	<2.0 E-08	<1.1 E-07	8.64 E-08	<6.7 E-09	<2.7 E-08	<4.0 E-08
Average % Moisture	75.5			73.4		

APPENDIX C-4
SUMMARY OF DIRECT RADIATION MONITORING

TABLE C-4-1

SUMMARY OF QUARTERLY AVERAGES OF TLD MEASUREMENTS FOR 1988

(Roentgen/quarter)

Location*	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Location Average
1	0.017 ± 0.002	0.023 ± 0.005	0.024 ± 0.003	0.023 ± 0.003	0.022 ± 0.003
2	0.017 ± 0.002	0.021 ± 0.001	0.023 ± 0.005	0.022 ± 0.003	0.021 ± 0.003
3	0.017 ± 0.002	0.020 ± 0.004	0.023 ± 0.003	0.021 ± 0.003	0.020 ± 0.003
4	0.019 ± 0.003	0.021 ± 0.002	0.023 ± 0.002	0.021 ± 0.007	0.021 ± 0.004
5	0.018 ± 0.003	0.022 ± 0.004	0.024 ± 0.005	0.025 ± 0.004	0.022 ± 0.004
6	0.018 ± 0.004	0.020 ± 0.003	0.024 ± 0.005	0.022 ± 0.003	0.021 ± 0.004
7	0.016 ± 0.003	0.020 ± 0.002	0.022 ± 0.002	0.024 ± 0.005	0.020 ± 0.003
8	0.017 ± 0.001	0.019 ± 0.003	0.023 ± 0.002	0.023 ± 0.004	0.020 ± 0.002
9	0.017 ± 0.003	0.020 ± 0.003	0.021 ± 0.002	0.021 ± 0.005	0.020 ± 0.003
10	0.018 ± 0.004	0.021 ± 0.005	0.023 ± 0.004	0.022 ± 0.005	0.021 ± 0.004
11	0.019 ± 0.005	0.023 ± 0.003	0.024 ± 0.003	0.026 ± 0.008	0.023 ± 0.005
12	0.017 ± 0.001	0.020 ± 0.004	0.022 ± 0.004	0.023 ± 0.004	0.020 ± 0.003
13	0.019 ± 0.005	0.022 ± 0.004	0.027 ± 0.004	0.025 ± 0.004	0.023 ± 0.004
14	0.019 ± 0.003	0.022 ± 0.004	0.025 ± 0.004	0.025 ± 0.005	0.023 ± 0.004
15	0.019 ± 0.002	0.021 ± 0.004	0.023 ± 0.003	0.023 ± 0.005	0.021 ± 0.004
16	0.020 ± 0.005	0.022 ± 0.005	0.024 ± 0.004	0.023 ± 0.004	0.023 ± 0.004
17	0.021 ± 0.003	0.028 ± 0.014	0.025 ± 0.003	0.025 ± 0.006	0.025 ± 0.006
18**	0.027 ± 0.003	0.029 ± 0.004	0.034 ± 0.005	0.038 ± 0.010	0.032 ± 0.005
19**	0.022 ± 0.003	0.023 ± 0.005	0.027 ± 0.003	0.028 ± 0.004	0.025 ± 0.004
20	0.019 ± 0.001	0.021 ± 0.004	0.022 ± 0.003	0.022 ± 0.007	0.021 ± 0.004
21	0.018 ± 0.006	0.020 ± 0.004	0.022 ± 0.003	0.021 ± 0.005	0.020 ± 0.004
22	0.018 ± 0.003	0.021 ± 0.002	0.022 ± 0.003	0.021 ± 0.003	0.020 ± 0.003
23	0.017 ± 0.004	0.020 ± 0.003	0.021 ± 0.003	0.020 ± 0.004	0.019 ± 0.003
24**	1.968 ± 0.306	1.627 ± 0.308	1.584 ± 0.194	1.634 ± 0.274	1.703 ± 0.270
25	0.038 ± 0.010	0.036 ± 0.007	0.039 ± 0.003	0.038 ± 0.008	0.038 ± 0.007
26	0.035 ± 0.007	0.039 ± 0.005	0.044 ± 0.020	0.037 ± 0.008	0.039 ± 0.010
27	0.020 ± 0.002	0.024 ± 0.004	0.027 ± 0.006	0.026 ± 0.005	0.024 ± 0.004
28	0.018 ± 0.003	0.024 ± 0.006	0.024 ± 0.003	0.024 ± 0.009	0.022 ± 0.005
29	0.024 ± 0.003	0.027 ± 0.006	0.031 ± 0.002	0.027 ± 0.009	0.027 ± 0.005
30	***	0.037 ± 0.007	0.037 ± 0.007	0.035 ± 0.010	0.036 ± 0.008
31	0.018 ± 0.005	0.022 ± 0.004	0.023 ± 0.002	0.023 ± 0.003	0.021 ± 0.004
32	0.018 ± 0.004	0.023 ± 0.002	0.027 ± 0.003	0.027 ± 0.005	0.024 ± 0.003
33	0.019 ± 0.004	0.025 ± 0.005	0.027 ± 0.005	0.030 ± 0.004	0.025 ± 0.005
34	0.021 ± 0.004	0.026 ± 0.008	0.034 ± 0.006	0.044 ± 0.006	0.031 ± 0.006
35	0.021 ± 0.004	0.029 ± 0.004	0.033 ± 0.005	0.040 ± 0.005	0.031 ± 0.005
36	0.027 ± 0.004	***	0.052 ± 0.011	0.055 ± 0.015	0.045 ± 0.010
37	0.018 ± 0.004	0.019 ± 0.004	0.021 ± 0.004	0.020 ± 0.004	0.019 ± 0.004
38**	0.050 ± 0.009	0.053 ± 0.008	0.052 ± 0.012	0.049 ± 0.009	0.051 ± 0.009
39**	0.015 ± 0.008	0.097 ± 0.008	0.100 ± 0.015	0.099 ± 0.018	0.100 ± 0.012
40**	0.251 ± 0.030	0.233 ± 0.037	0.217 ± 0.021	0.239 ± 0.045	0.235 ± 0.033
Quarterly Average**	0.020 ± 0.004	0.024 ± 0.004	0.027 ± 0.004	0.027 ± 0.006	0.024 ± 0.004

* Locations shown on Figures A-3 and A-6.

** TLDs 18, 19, 24, 38, 39 and 40 are not included in the quarterly averages.

*** TLD Package Missing

APPENDIX C-5
SUMMARY OF NONRADIOLOGICAL MONITORING

SUMMARY OF NONRADIOLOGICAL MONITORING

Nonradiological emissions and plant effluents are controlled and permitted under New York State and U.S. EPA regulations. Airborne emissions arise from ten sources, all of which are permitted by the New York State Department of Environmental Conservation. These release points include two natural gas-fired boilers, two nitric acid tank vents, an office paper waste incinerator, a glass-melter off-gas system and a cement storage silo vent. The melter off-gas system is currently being tested and operated under a permit to construct. These permits are identified and described in Table C-5.1. Although there are periodic New York State inspections of the air emission points, routine sampling and analysis of nonradiological emissions from these points are not required. Discharges from these points are well below the levels requiring monitoring under the state permit system.

Liquid discharges are regulated under the State Pollution Discharge Elimination System (SPDES). The outfalls and monitoring requirements for the permit are presented in Table C-5.2. The locations of the monitoring points are shown in Figure C-5.1.

The results of the SPDES nonradiological monitoring are presented in Figures C-5.2 through C-5.31. These data indicate that, overall, project effluents were within permit limits during 1988. However, the WVDP reported a total of 24 noncompliance episodes. These are summarized in Table C-5.3 and are described in the following paragraphs.

Outfall 007, the mixing basin for sanitary and utility waste waters, experienced 14 noncompliance episodes. Of the 14 excursions, 12 were for pH and two for solids (one suspended and one settleable). The pH excursions were all, without exception, the result of several waste streams that had not been neutralized before entering the equalization basin. Once this situation was confirmed, an acid addition system was placed in line to automatically control the pH of the combined waste streams. The acid addition system coupled with the planned addition of a constant pH monitor, planned for installation in 1989, will eliminate the pH excursions at this outfall.

The remaining two excursions at outfall 007 were for solids. These excursions were caused by an upset in the Sewage Treatment Plant (STP) during which excess solids were discharged from the STP clarifier into the STP effluent stream. The excess sludge was subsequently pumped out and sent off site for disposal.

Throughout the year a substantial amount of time and effort was put into the equalization basin system. The system itself was updated, including draining the basin and cleaning the liner of sludge, placing the bottom drain into service as originally intended, and installing an aeration pump in the basin. Personnel training was improved by qualifying STP operators according to NYSDEC guidance.

Outfall 001, the batch discharge from the LLWTF, experienced only two excursions. The first was for pH and occurred during the initial hours of a batch discharge. When a prequalification analysis indicated that the effluent was within permit limits, the discharge was started. However, a sample collected several hours later indicated pH was beyond the allowable range. The discharge was terminated, the pH was adjusted, and the discharge was restarted and completed without further incident.

The second excursion at outfall 001 was for total suspended solids which exceeded the permit limit for daily average but did not exceed the daily maximum. The cause of this excursion was a resuspension of sediments in

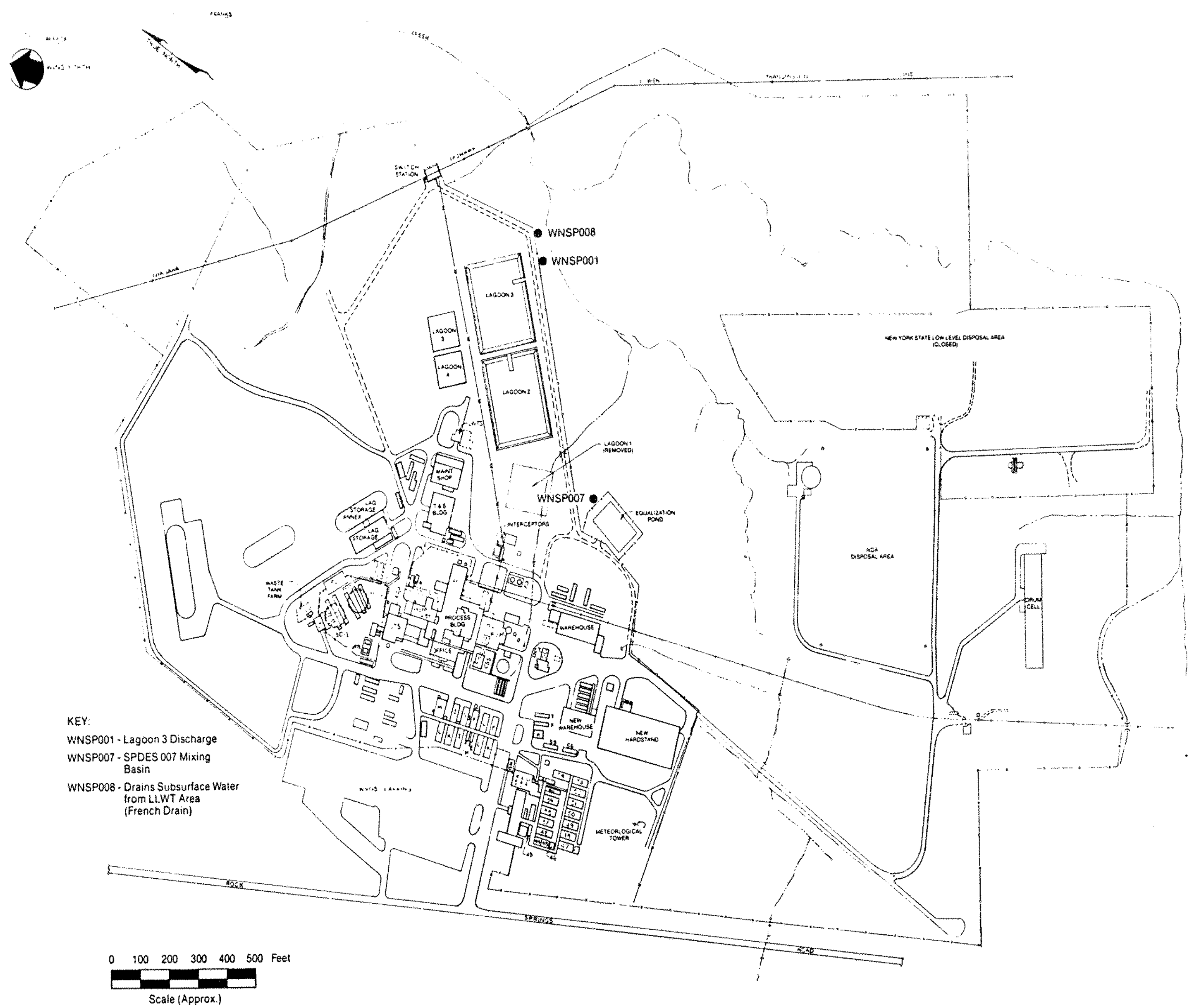

Figure C-5.1. Location of SPDES Monitoring Points.

the lagoon water from the sparging action used to maintain pH limits.

The remaining eight noncompliance episodes were for the sum totals of outfalls 001, 007, and 008, which is effluent from the french drain on the perimeter of the low-level waste treatment facility storage lagoons. Six of the excursions were for total iron. The calculated iron concentration exceeded the daily maximum of 0.31 mg/L allowed in the permit. These excursions can be attributed to the natural variability of iron in the Project's raw water supply, which is used as a background iron concentration and subsequently subtracted from the Project's effluents.

The remaining two excursions were for BOD-5 that exceeded the permit limit of 5.0 mg/L. Both incidents were a result of the proliferation of algae in the equalization basin (outfall 007). The problem was identified and an SOP was developed to control the time effluent remains in the basin, thereby reducing the time and opportunity for an algae bloom to flourish.

These noncompliance episodes are summarized in Table C-5.3. The environmental impacts associated with these episodes are negligible because of their general small magnitude, short duration, and the naural dilution between the discharge point and Cattaraugus Creek (the nearest point of public access).

TABLE C-5.1
WEST VALLEY DEMONSTRATION PROJECT ENVIRONMENTAL PERMITS

Permit #	Issued by	Expiration Date	Type of Permit
042200-0114-00002 WC	NYSDEC	6/89	Certificate to operate air contamination source -boiler
042200-0114-00003 WC	NYSDEC	6/89	Certificate to operate air contamination source -boiler
042200-0114-00004 WR	NYSDEC	6/89	Certificate to operate air contamination source -incinerator**
042200-0114-00010 WI	NYSDEC	6/89	Certificate to operate air contamination source Low Level Waste Treatment Facility Nitric Acid Storage Tank
042200-0114-014D1 WI	NYSDEC	6/89	Certificate to operate air contamination source Nitric Acid Bulk Storage Tank
042200-0114-CSS01	NYSDEC	6/89	Certificate to Operate Cement Storage Silo Ventilation System
042200-0114-015F-1	NYSDEC	6/86*	Permit to Construct Vitrification Off-Gas System
042200-0114-CTS01	NYSDEC	3/90	Permit to construct CTS cold chemical makeup system***
042200-0114-CTS02	NYSDEC	3/90	Permit to construct CTS cold chemical makeup system***
042200-01140-CTS03	NYSDEC	3/90	Permit to construct CTS cold chemical makeup system***
NY-0000973	NYSDEC	9/90	State Pollution Discharge Elimination System (SPDES permit)
WVDP-187-01	EPA		Certificate to Operate Radioactive Air Source - Building 01-14 Ventilation System****

TABLE C-5.1
WEST VALLEY DEMONSTRATION PROJECT ENVIRONMENTAL PERMITS (CONTINUED)

Permit #	Issued by	Expiration Date	Type of Permit
WVDP-287-01	EPA		Certification to Operate Radioactive Air Source - Contact Size Reduction & Decontamination Facility****
WVDP-387-01	EPA		Certification to Operate Radioactive Air Source–Supernatant Treatment Ventilation System****
WVDP-487-01	EPA		Certificate to Operate Radioactive Air Source–Low-Level Waste Supercompactor Ventilation System***
WVDP-587	EPA		Certificate to Operate Radioactive Air Source - Outdoor Ventilation-Exhaust****
WVDP-687-01	EPA		Certificate to Operate Radioactive Air Source - Liquid Waste Treatment System (modification of Process Building Ventilation System)****
*****	EPA	N/A	Permit to construct or modify sources of atmospheric emissions of radionuclides - Analytical Chemistry Laboratories (modification of Process Building Ventilation System)

* Permit to construct is extended annually with submittal of status report.
**Currently nonradioactive waste is removed to a commercial landfill and not incinerated.
***Permits were not obtained until March 1989.
****National Emission Standard for Hazardous Air Pollutants (NESHAP) temporary permits are valid until the final permits are issued.
*****Pending EPA approval - Request for approval to construct or modify was submitted to the EPA on February 26, 1989.

TABLE C-5.2
WEST VALLEY DEMONSTRATION PROJECT SPDES SAMPLING PROGRAM
Effective September 1, 1985

Outfall	Parameter	Limit	Sample Frequency
001 (Process and Storm waste waters)	Flow	Monitor	2 per discharge event
	Aluminum, Total	14.0 mg/L	2 per discharge event
	Ammonia (as NH_3)	*	2 per discharge event
	Arsenic, Dissolved	0.15 mg/L	2 per discharge event
	BOD-5	**	2 per discharge event
	Iron, Total	**	2 per discharge event
	Zinc, Total Recoverable (Rec.)	0.48 mg/L	2 per discharge event
	Solids, Suspended	45.0 mg/L	2 per discharge event
	Cyanide, Amenable to Chlor.	0.022 mg/L	2 per discharge event
	Solids, Settleable	0.30 mL/L	2 per discharge event
	pH (Range)	6.0 - 9.0	2 per discharge event
	Oil & Grease	15.0 mg/L	2 per discharge event
	Sulfate***	Monitor	2 per discharge event
	Nitrate***	Monitor	2 per discharge event
	Nitrite***	Monitor	2 per discharge event
	Chromium (Hexavalent) Total Rec.***	0.016 mg/L	2 per discharge event
	Cadmium, Total Rec.***	0.007 mg/L	2 per discharge event
	Copper, Total Rec.***	0.03 mg/L	2 per discharge event
	Lead, Total Rec.***	0.15 mg/L	2 per discharge event
	Chromium, Total	0.050 mg/L	annual
	Nickel, Total	0.080 mg/L	annual
	Selenium, Total	0.040 mg/L	annual
	Barium***	0.5 mg/L	annual
	Antimony***	1.0 mg/L	annual
	Chloroform***	0.3 mg/L	annual
007 (Sanitary and Utility waste water)	Flow	Monitor	3 per month
	Ammonia (as NH_3)	*	3 per month
	BOD-5	**	3 per month
	Iron, Total	**	3 per month
	Suspended Solids	45.0 mg/L	2 per month
	Settleable Solids	0.3 mL/L	Weekly
	pH (Range)	6.0 - 9.0	Weekly
	Chloroform	0.020 mg/L	annual
008 (French Drain waste water)	Flow	Monitor	3 per month
	BOD-5	**	3 per month
	Iron	**	3 per month
	pH (Range)	6.0 - 9.0	3 per month
	Silver,Total	0.008 mg/L	annual
	Zinc, Total	0.100 mg/L	annual

* Reported as flow weighted average of Outfalls 001 and 007.
** Reported as flow weighted average of Outfalls 001, 007 and 008. Iron data are net limits reported after background concentrations are subtracted.
*** Parameters added in SPDES permit modification May 20, 1988.

Table C-5.3
WEST VALLEY DEMONSTRATION PROJECT 1988 SPDES NON-COMPLIANCE EPISODES

Date	Outfall	Parameter	Limit	Value	Comments
Feb 88	007	pH	6.0 - 9.0	9.89	
Mar 88	001	pH	6.0 - 9.0	5.62	
Mar 88	007	pH	6.0 - 9.0	min. 2.51 max. 11.30	seven occasions reported
Apr 88	Sum 001, 007 & 008	Fe	0.31 mg/L daily max.	0.76 mg/L	
Apr 88	007	pH	6.0 - 9.0	2.87	two occasions reported
May 88	007	pH	6.0 - 9.0	9.39	
Jul 88	Sum 001, 007 & 008	BOD-5	5.0 mg/L daily average	5.41 mg/L	
Jul 88	Sum 001, 007 & 008	Fe	0.31 mg/L daily max.	0.38 mg/L	
Sep 88	Sum 001, 007 & 008	BOD-5	5.0 mg/L daily average	5.80 mg/L	
Sep 88	Sum 001, 007 & 008	Fe	0.31 mg/L daily max.	0.40 mg/L	
Oct 88	001	Total Suspended Solids	30.0 mg/L avg. 45.0 mg/L max.	36.16 mg/L	
Oct 88	Sum 001, 007 & 008	Fe	0.31 mg/L daily max.	0.78 mg/L	
Oct 88	007	pH	6.0 - 9.0	3.98	
Oct 88	007	Total Suspended Solids	30.0 mg/L avg. 45.0 mg/L max.	55.08 mg/L	
Oct 88	007	Settleable Solids	0.3 ml/L	1.5 ml/L	
Nov 88	Sum 001, 007 & 008	Fe	0.31 mg/L daily max.	0.74 mg/L	two occasions reported

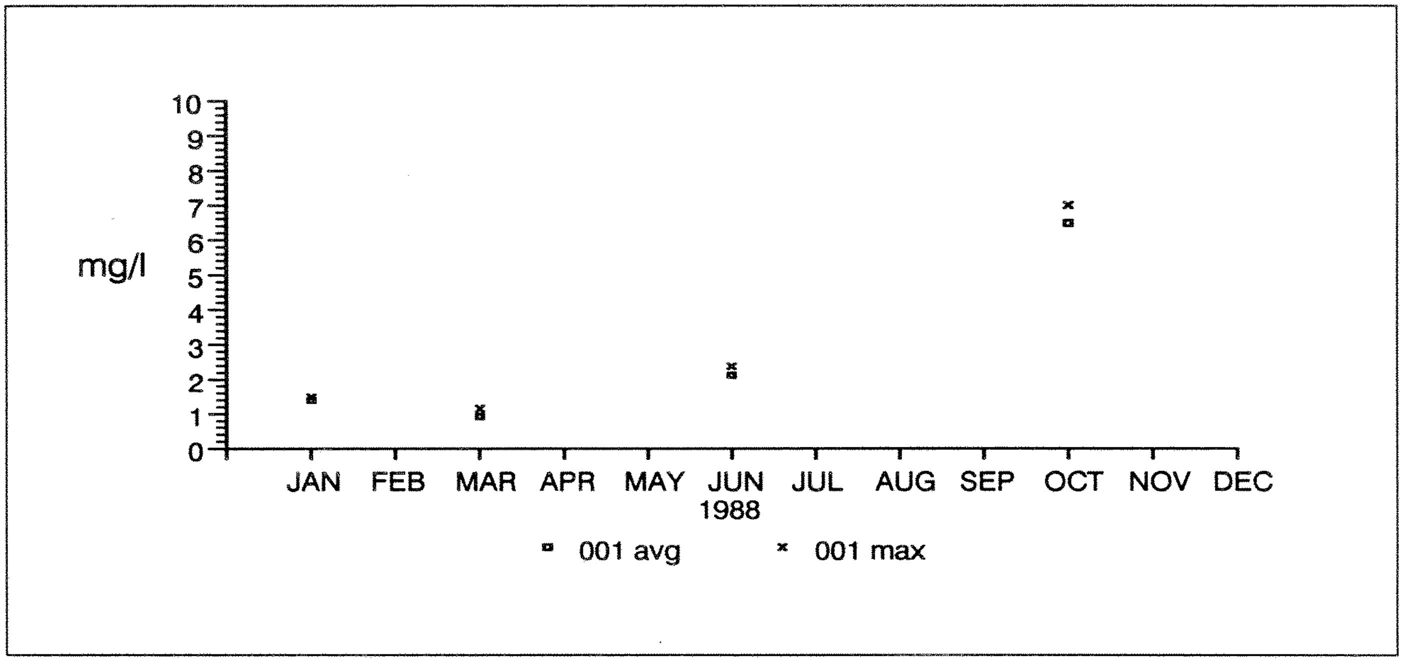

Figure C-5.2 BOD-5, Outfall 001.

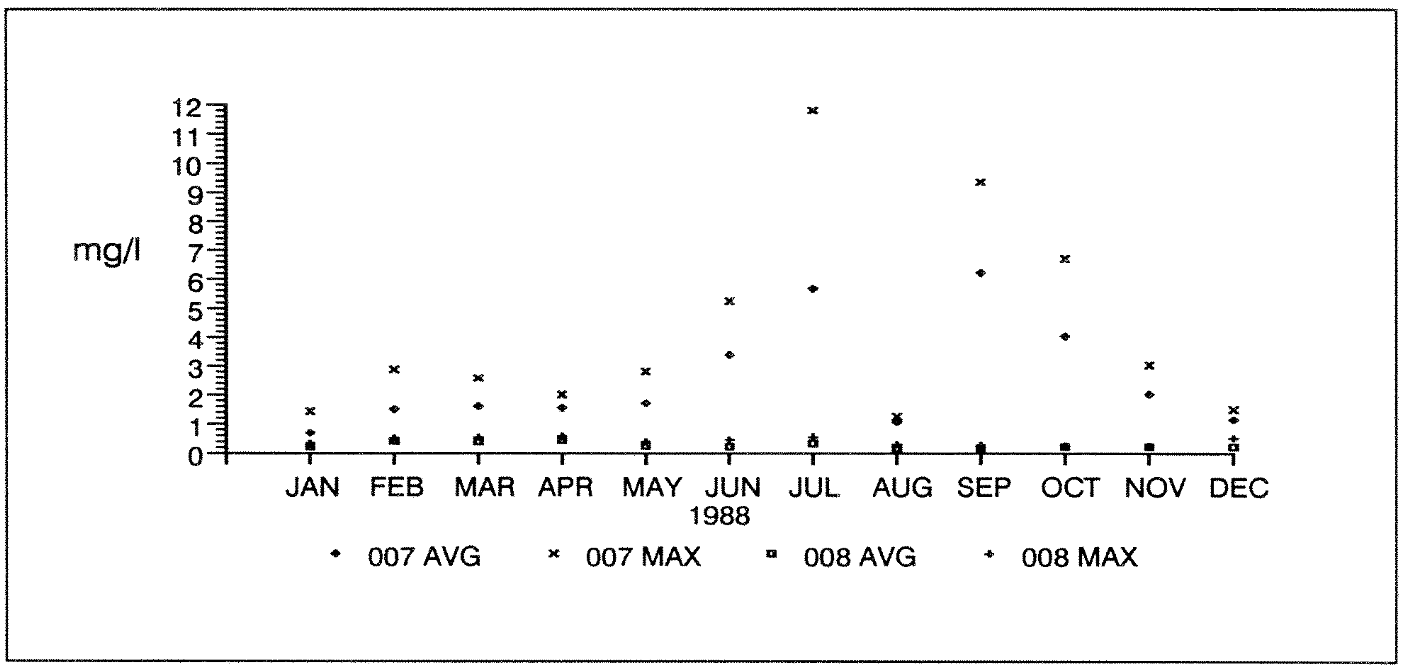

Figure C-5.3 BOD-5, Outfalls 007 and 008.

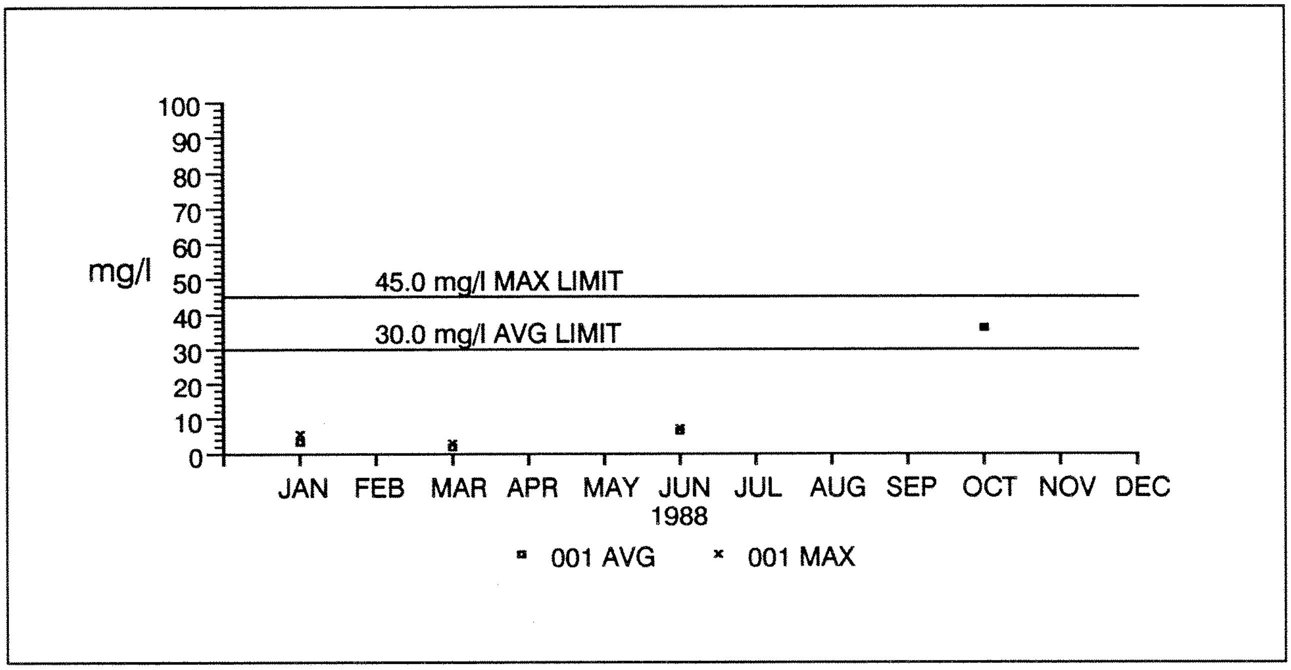

Figure C-5.4 Suspended Solids, Outfall 001.

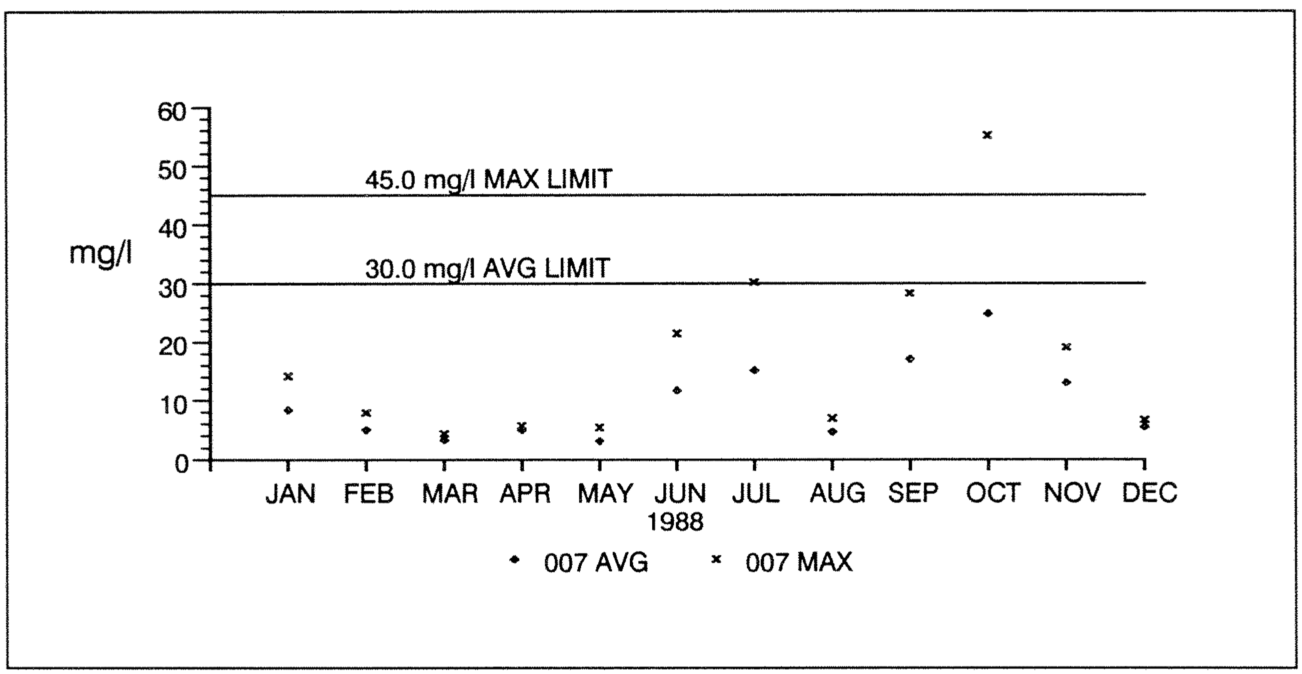

Figure C-5.5 Suspended Solids, Outfall 007.

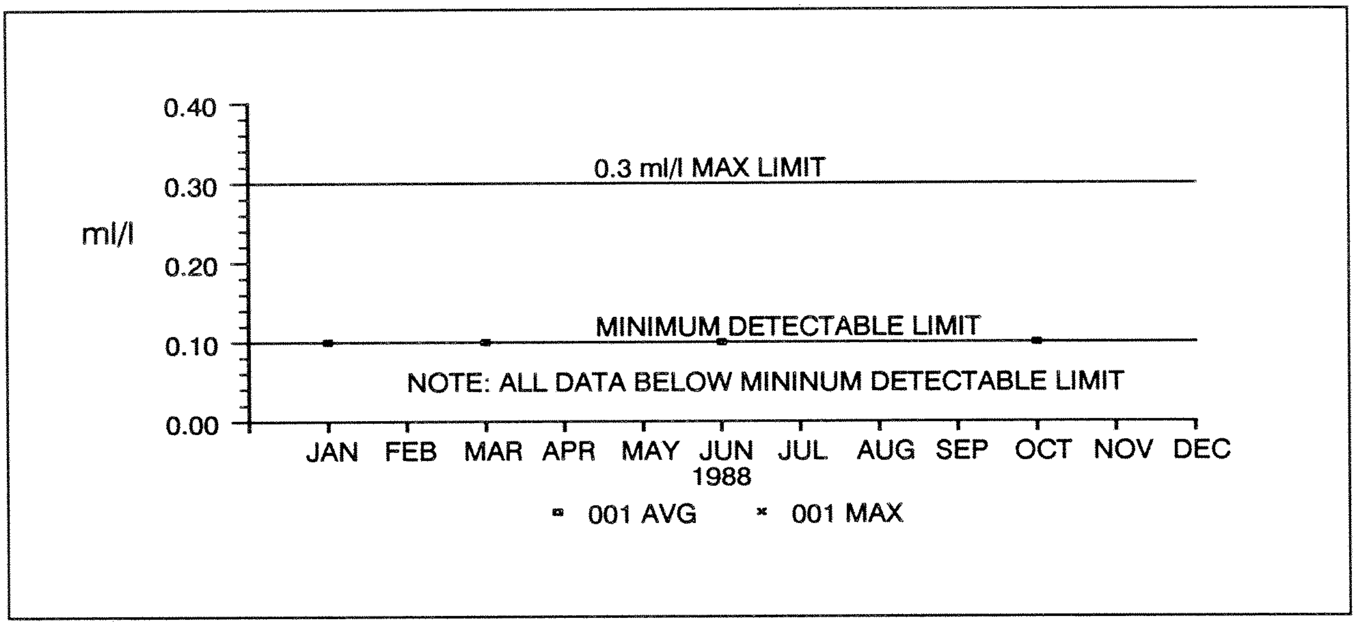

Figure C-5.6 Settleable Solids, Outfall 001.

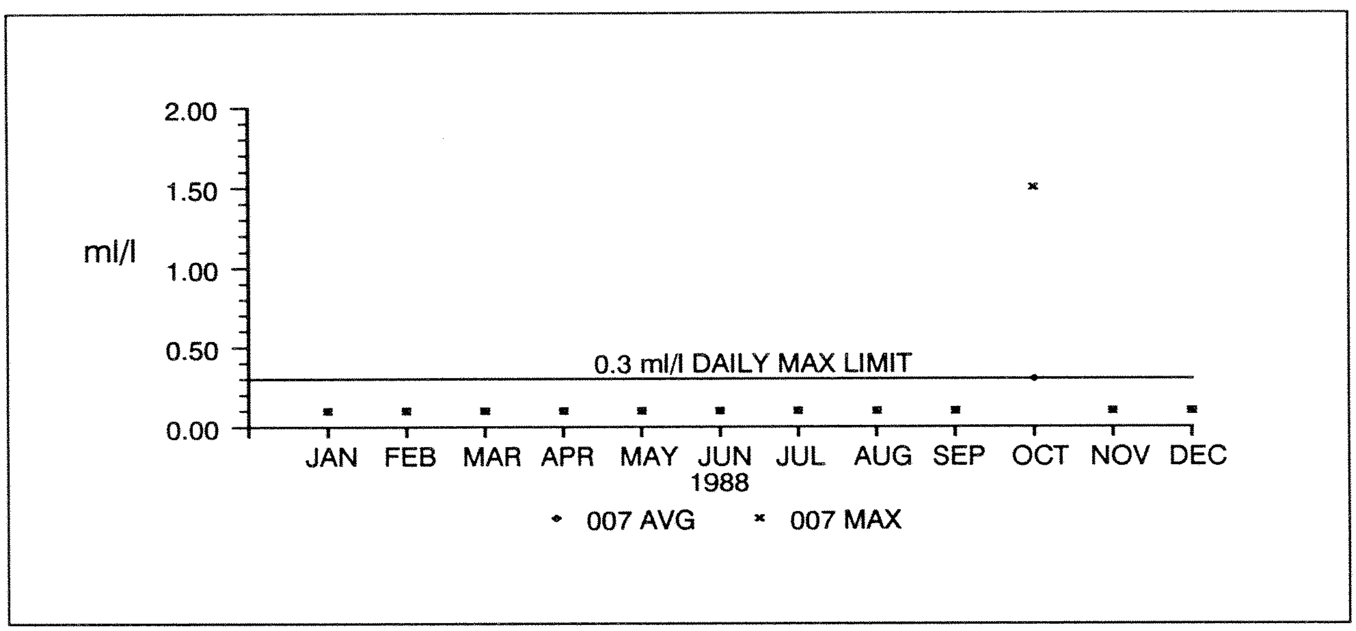

Figure C-5.7 Settleable Solids, Outfall 007.

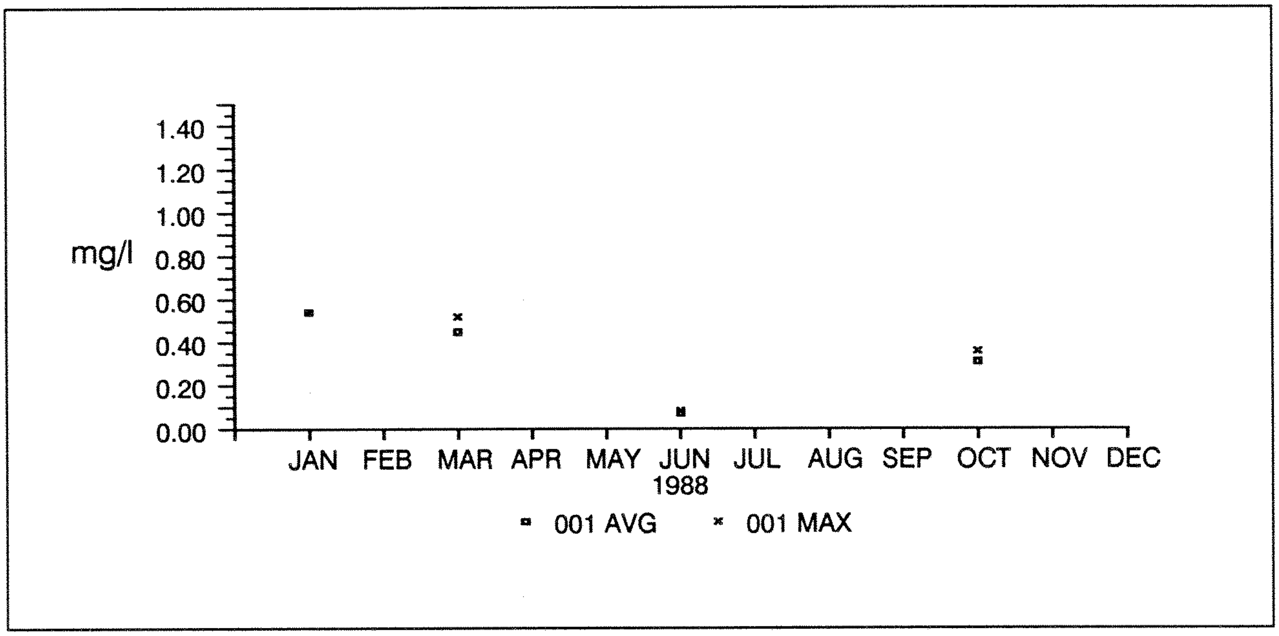

Figure C-5.8 Ammonia, Outfall 001.

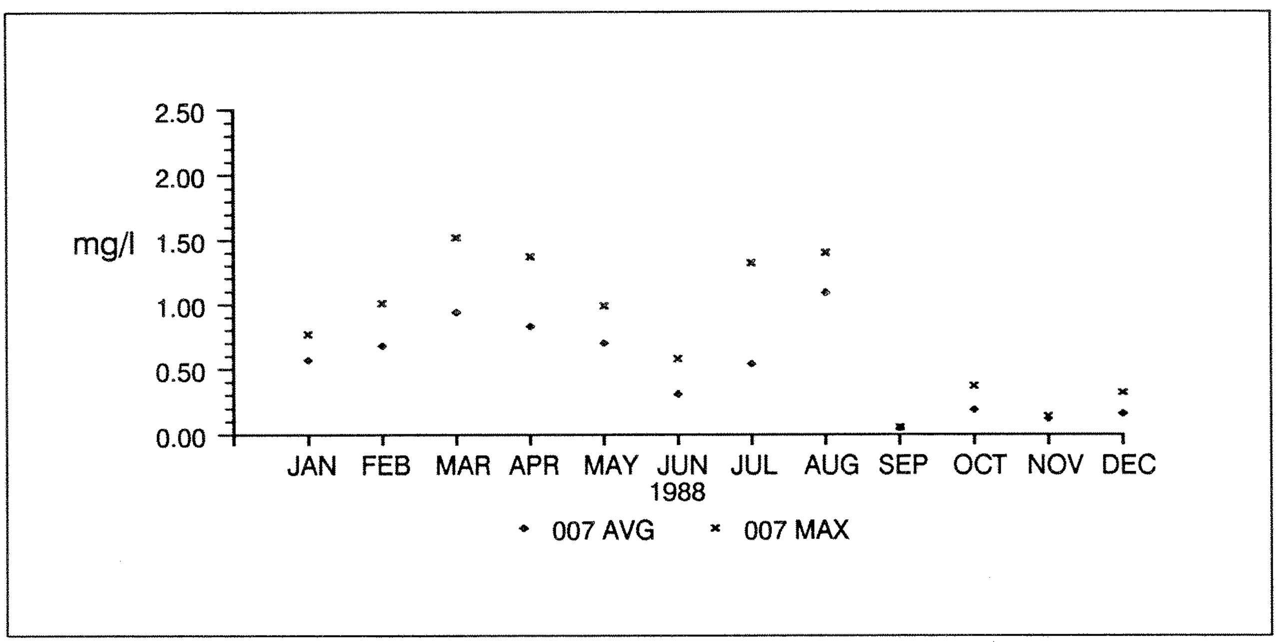

Figure C-5.9 Ammonia, Outfall 007.

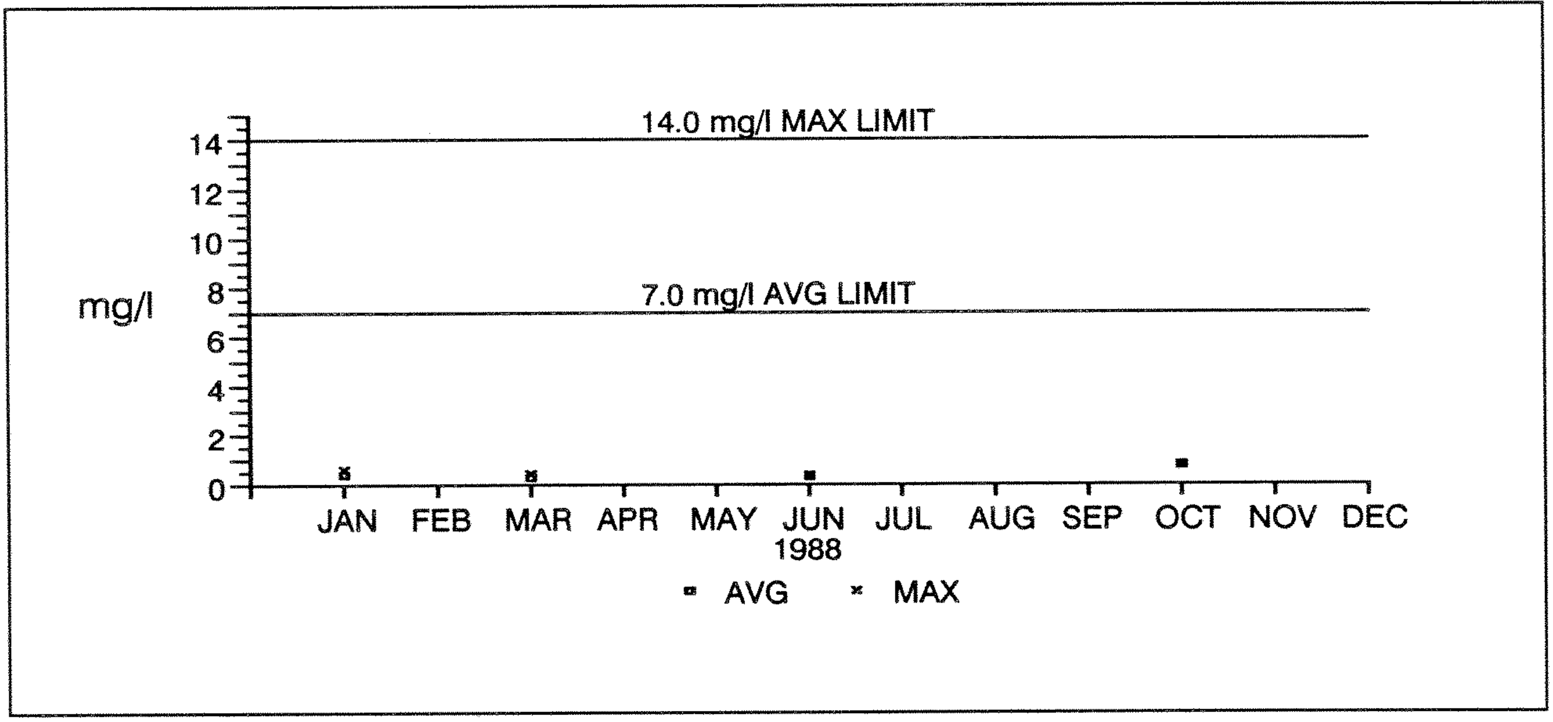

Figure C-5.10 Metals, Aluminum (Al), Outfall 001.

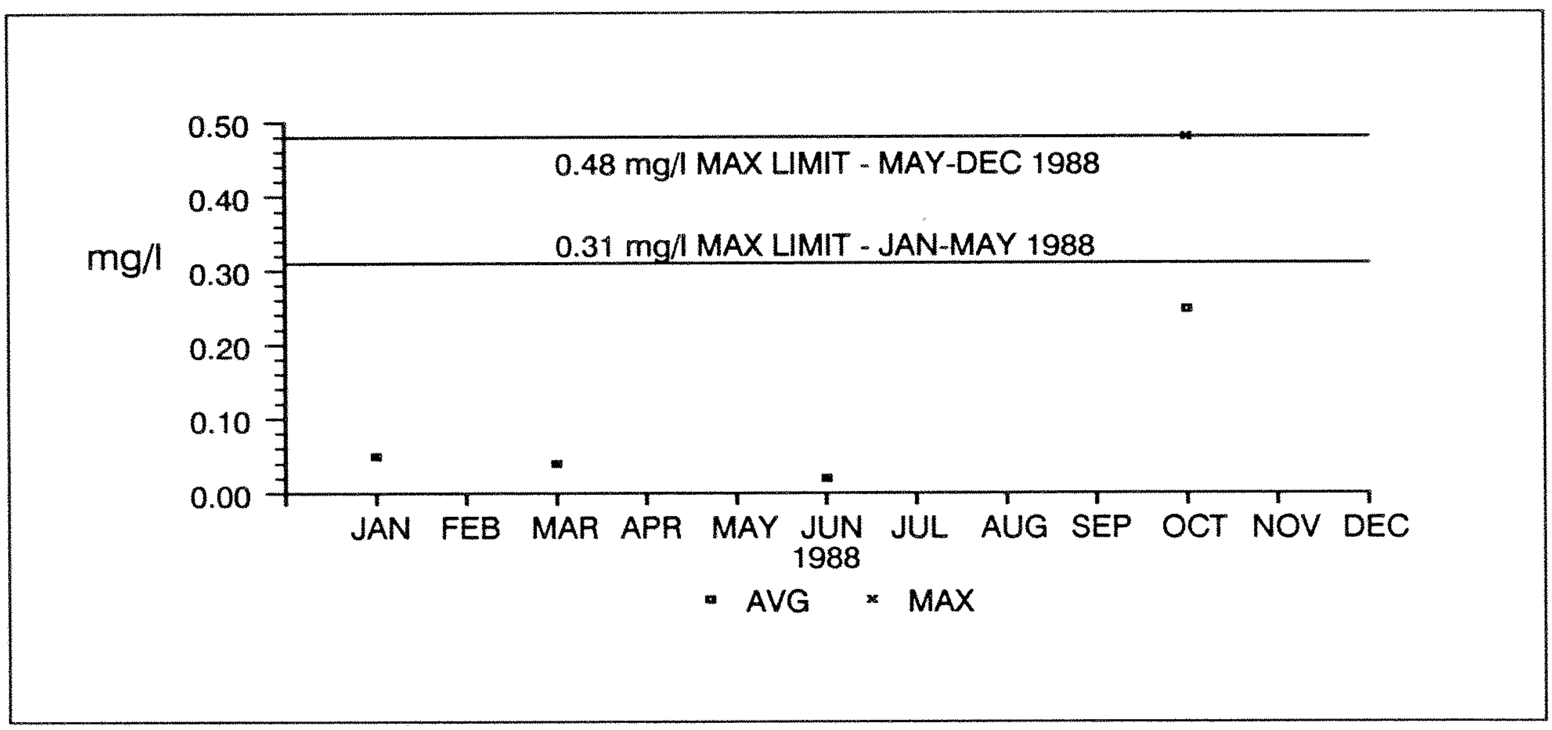

Figure C-5.11 Metals, Zinc (Zn), Outfall 001.

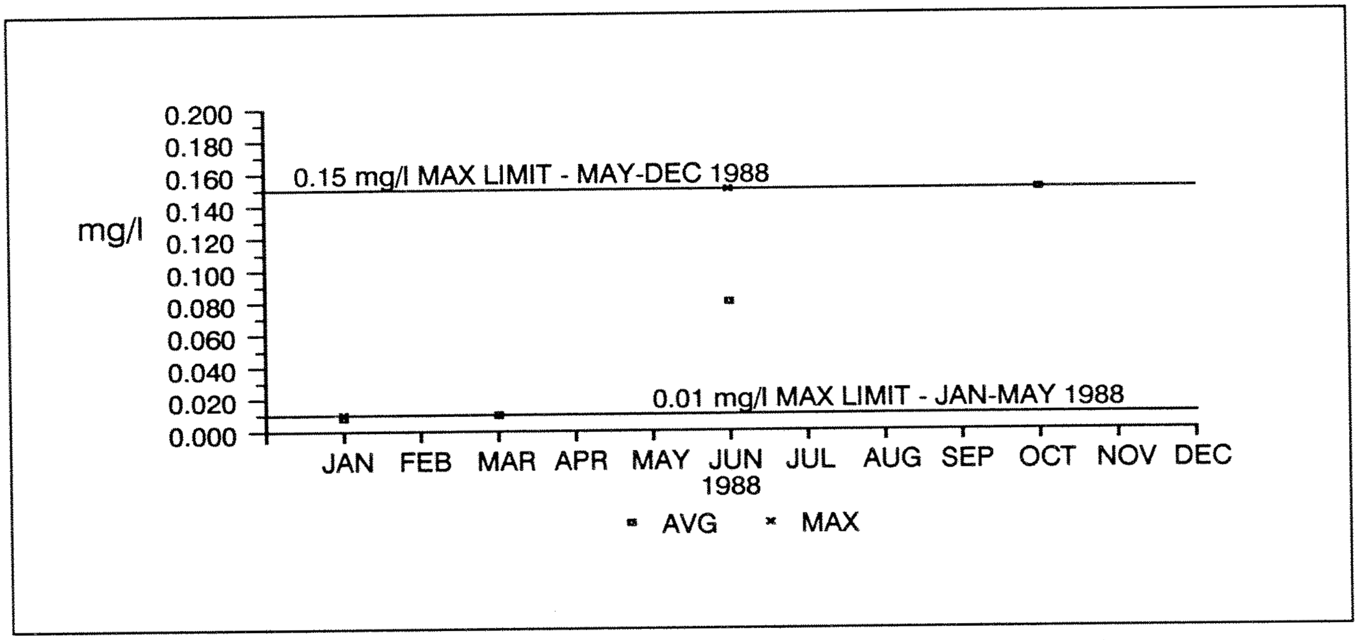

Figure C-5.12 Metals, Arsenic (As), Outfall 001.

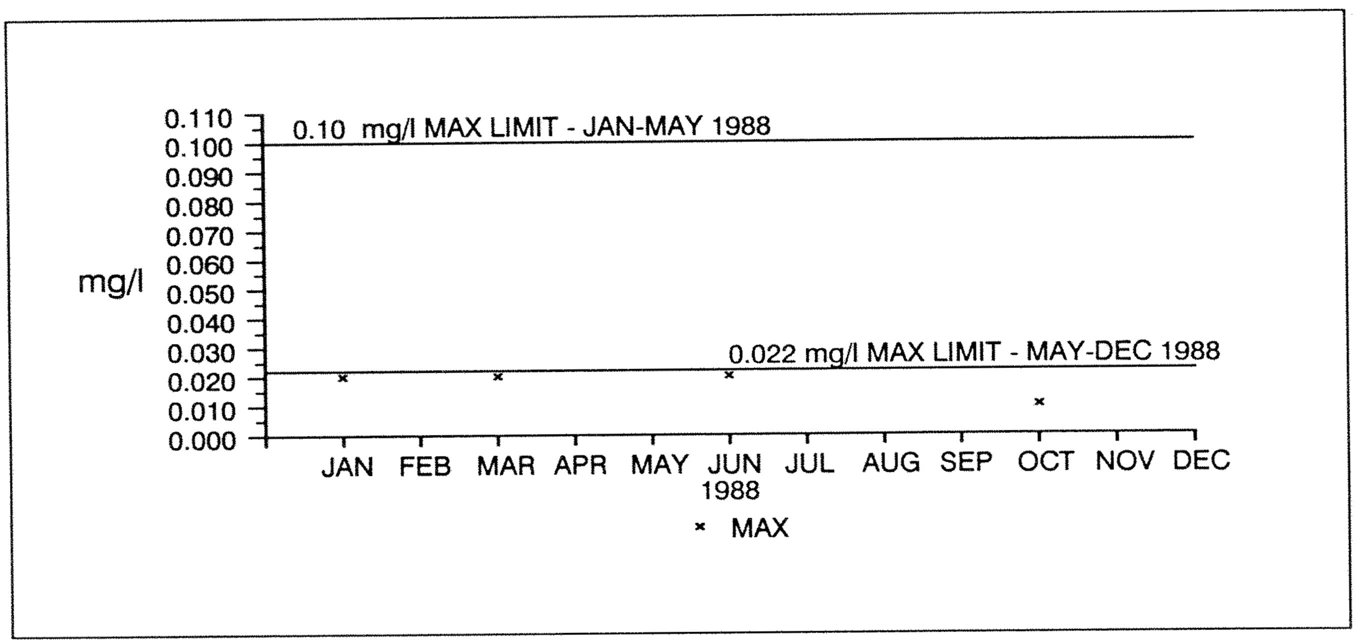

Figure C-5.13 Cyanide, Outfall 001.

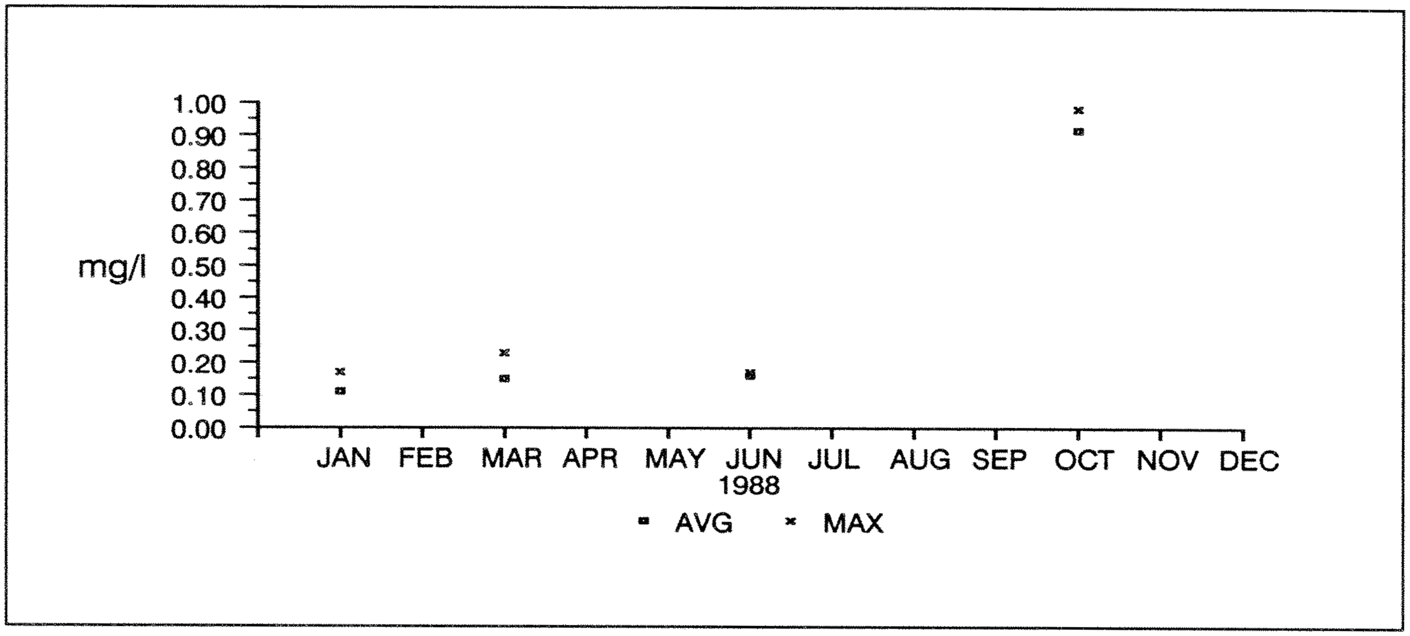

Figure C-5.14 Metals, Iron (Fe), Outfall 001.

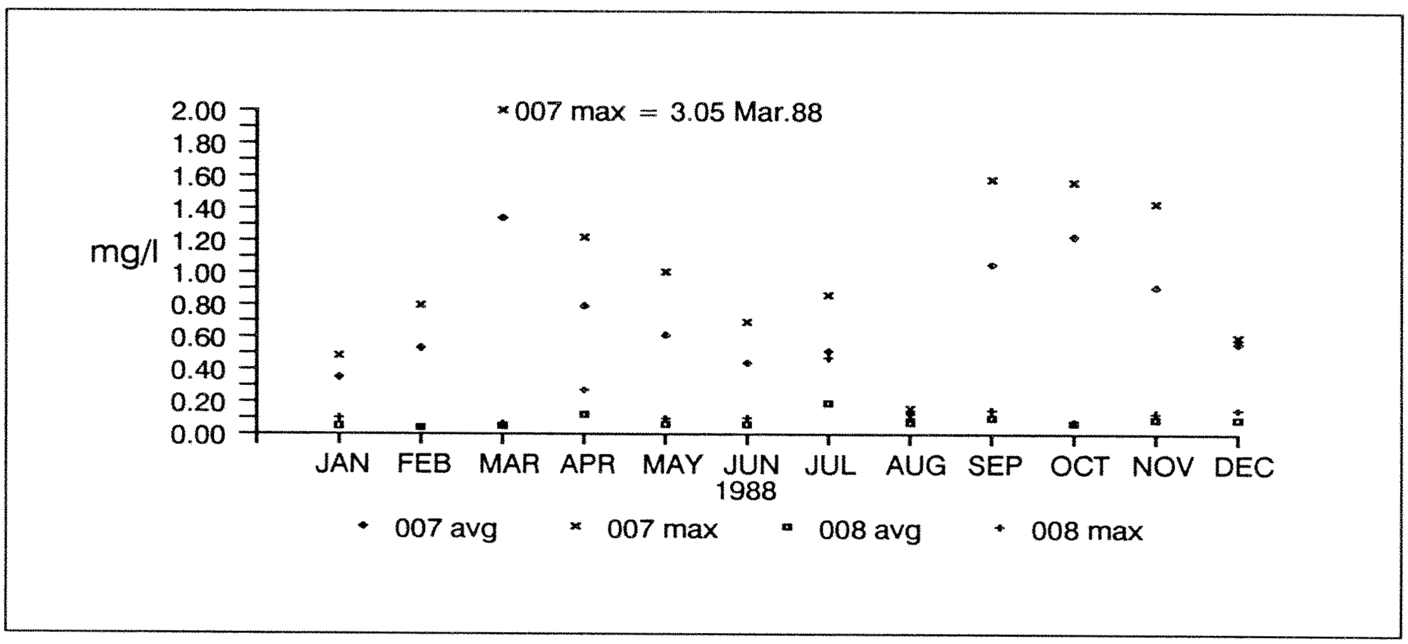

Figure C-5.15 Metals, Iron (Fe), Outfalls 007 and 008.

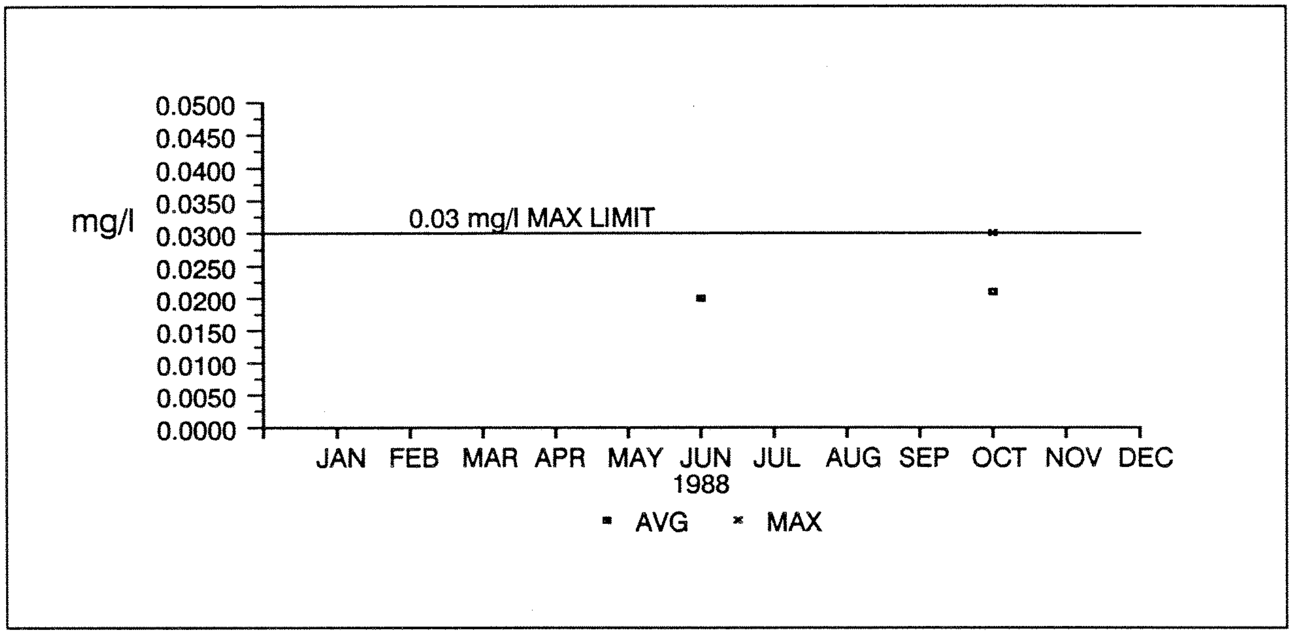

Figure C-5.16 Metals, Copper (Cu), Outfall 001.

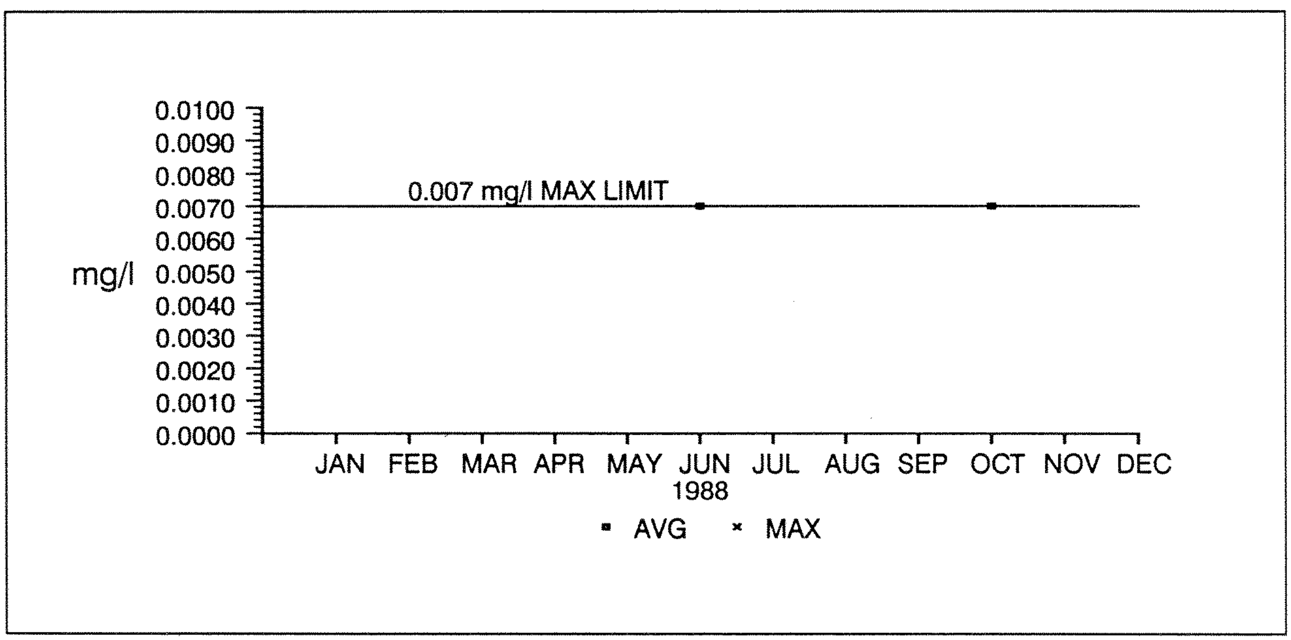

Figure C-5.17 Metals, Cadmium (Cd), Outfall 001.

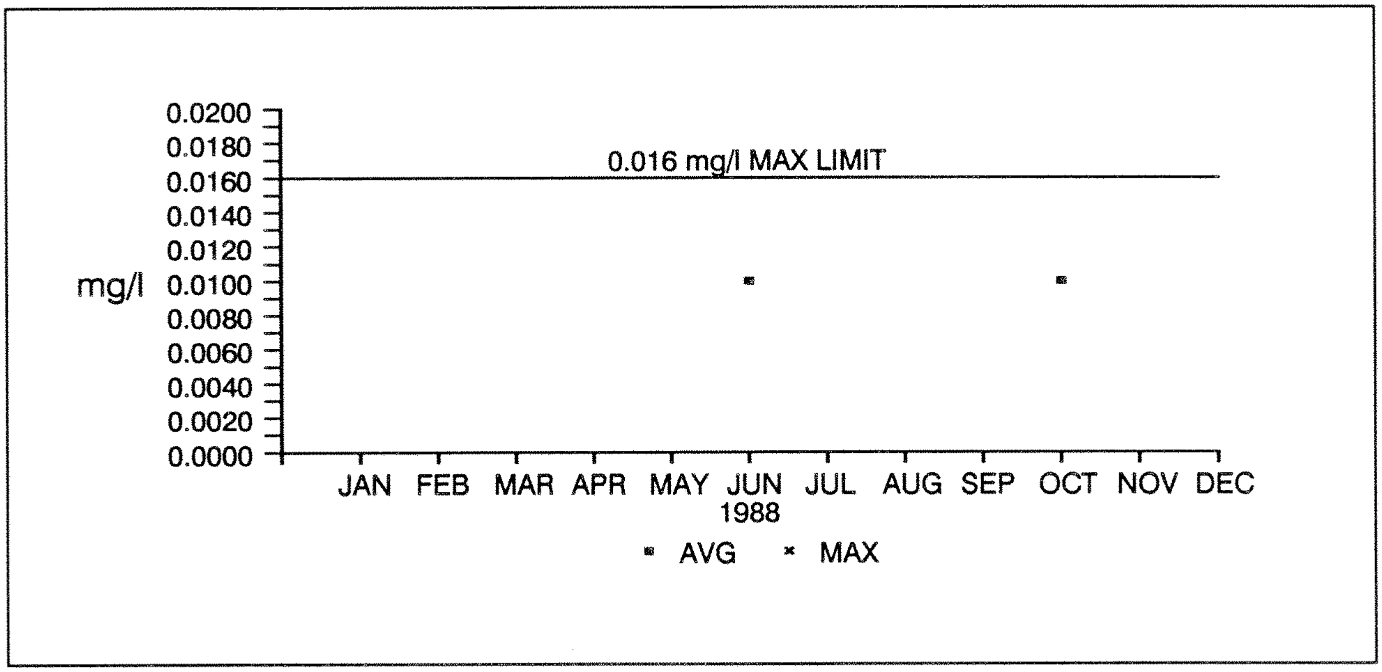

Figure C-5.18 Metals, Chromium (Cr), Outfall 001.

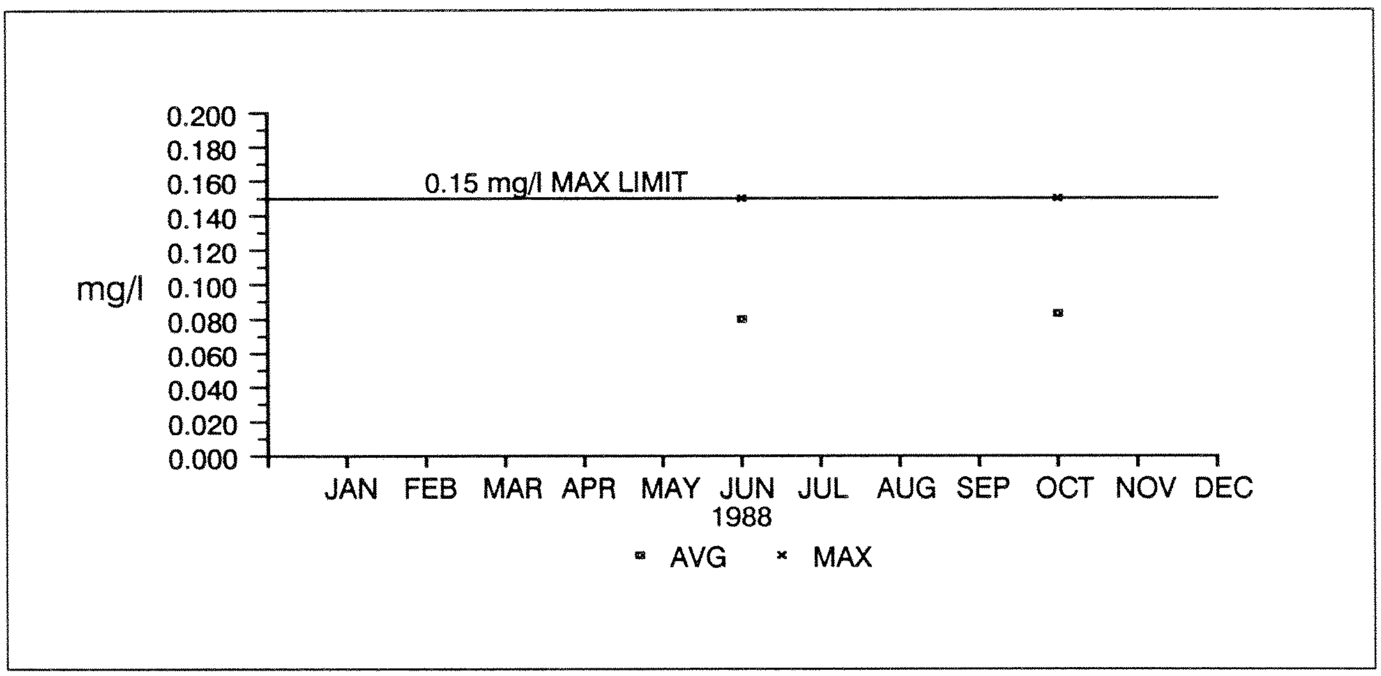

Figure C-5.19 Metals, Lead (Pb), Outfall 001.

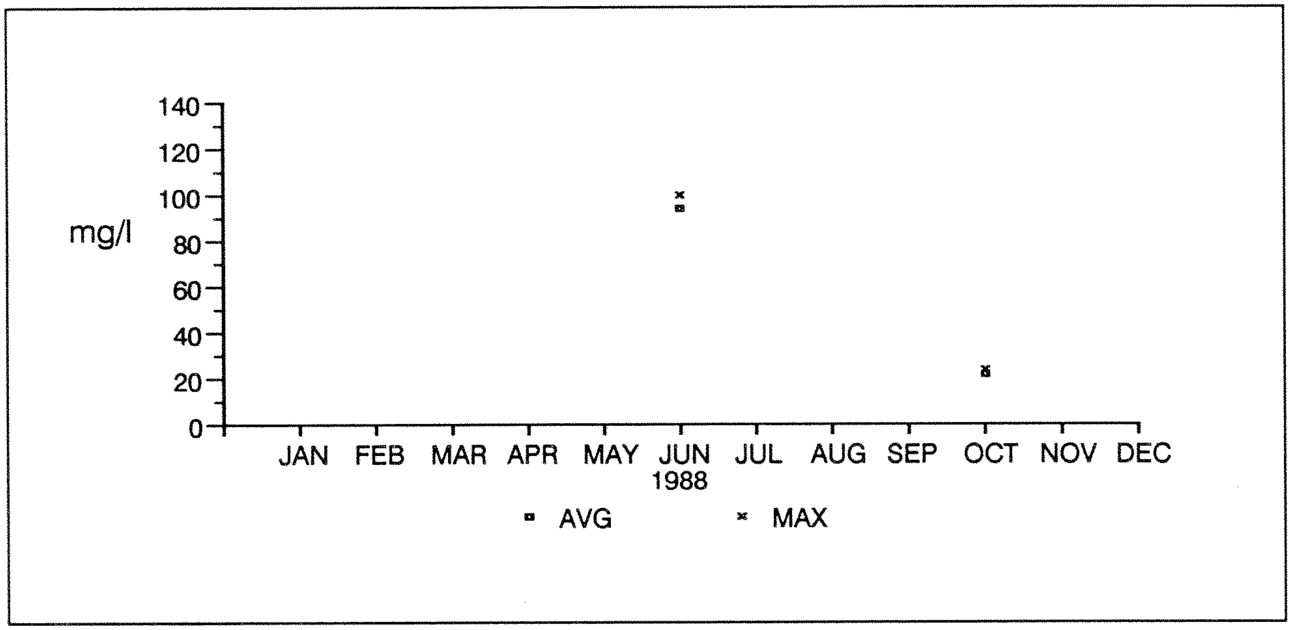

Figure C-5.20 Nitrate, Outfall 001.

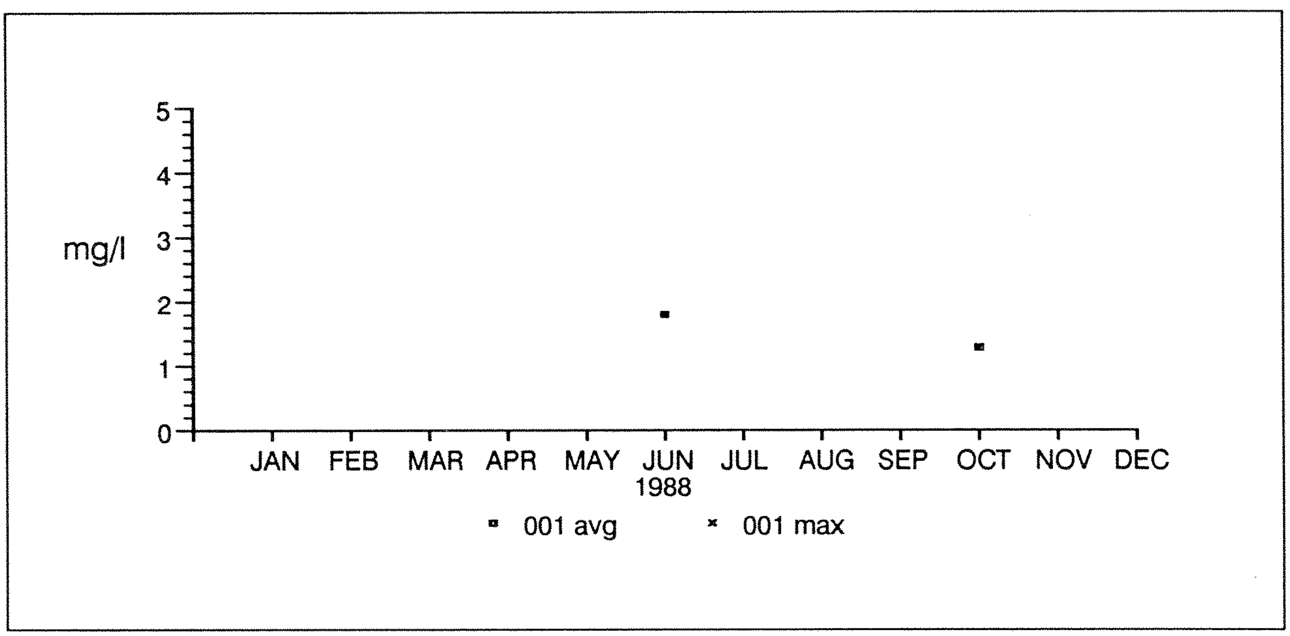

Figure C-5.21 Nitrite, Outfall 001.

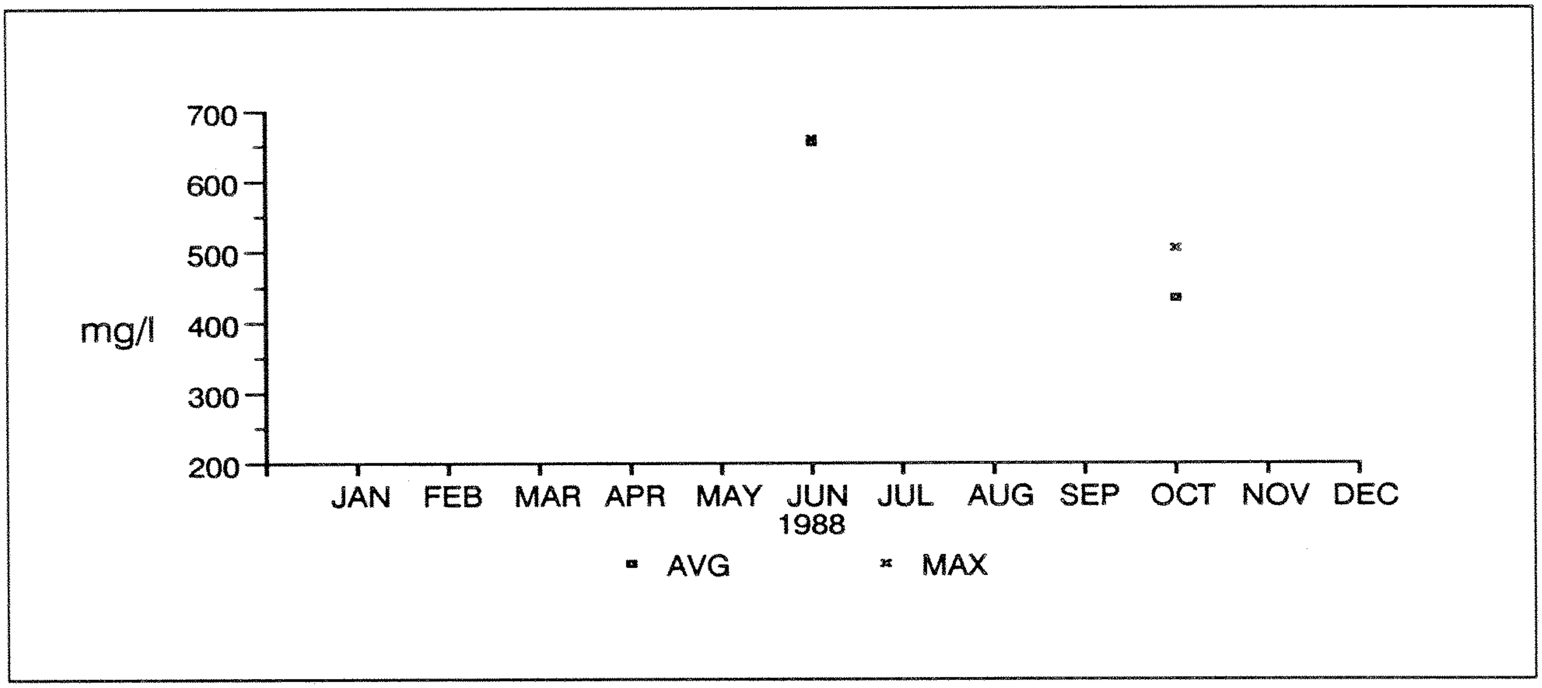

Figure C-5.22 Sulfate, Outfall 001.

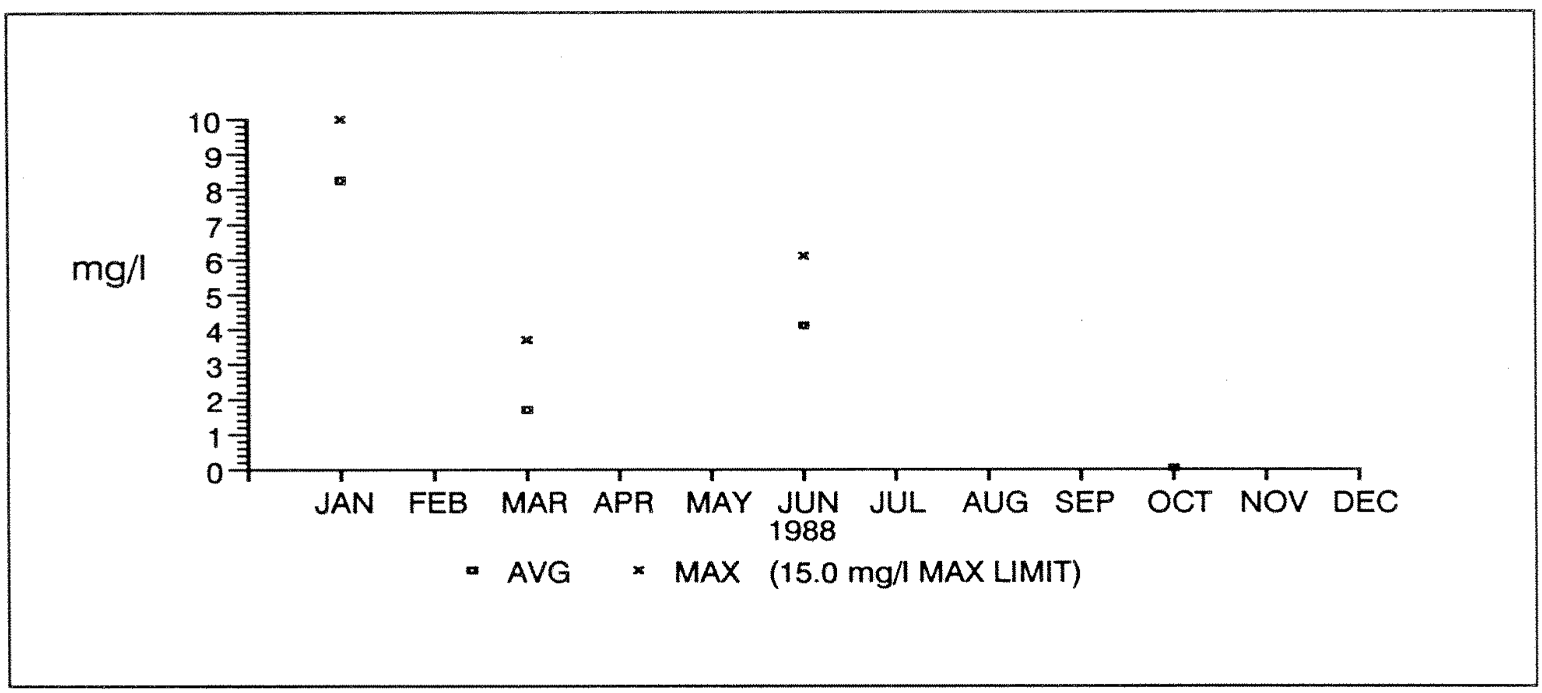

Figure C-5.23 Oil and Grease, Outfall 001.

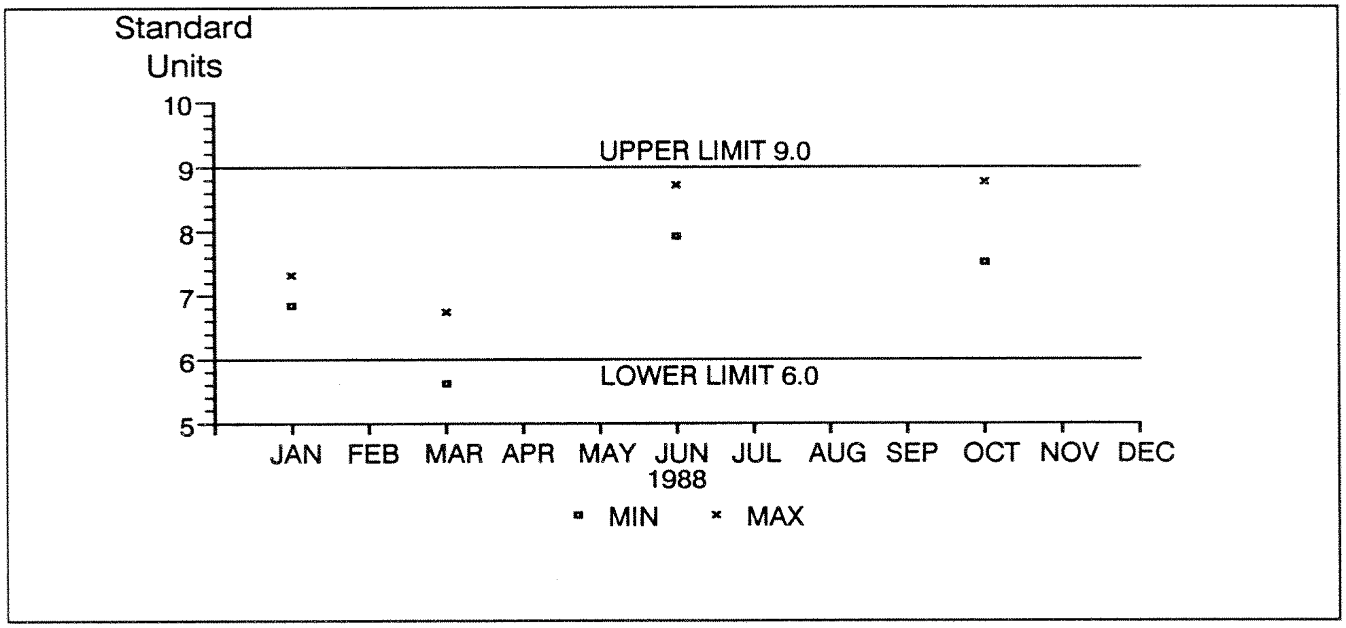

Figure C-5.24 pH, Outfall 001.

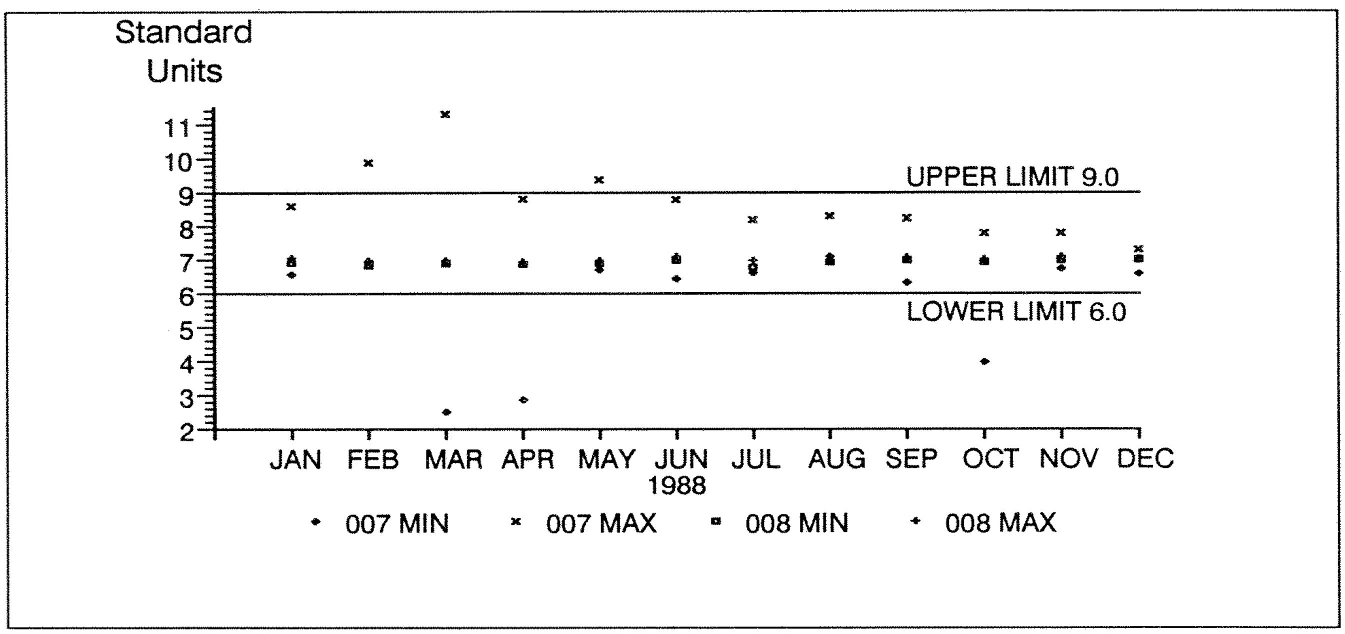

Figure C-5.25 pH, Outfalls 007 and 008.

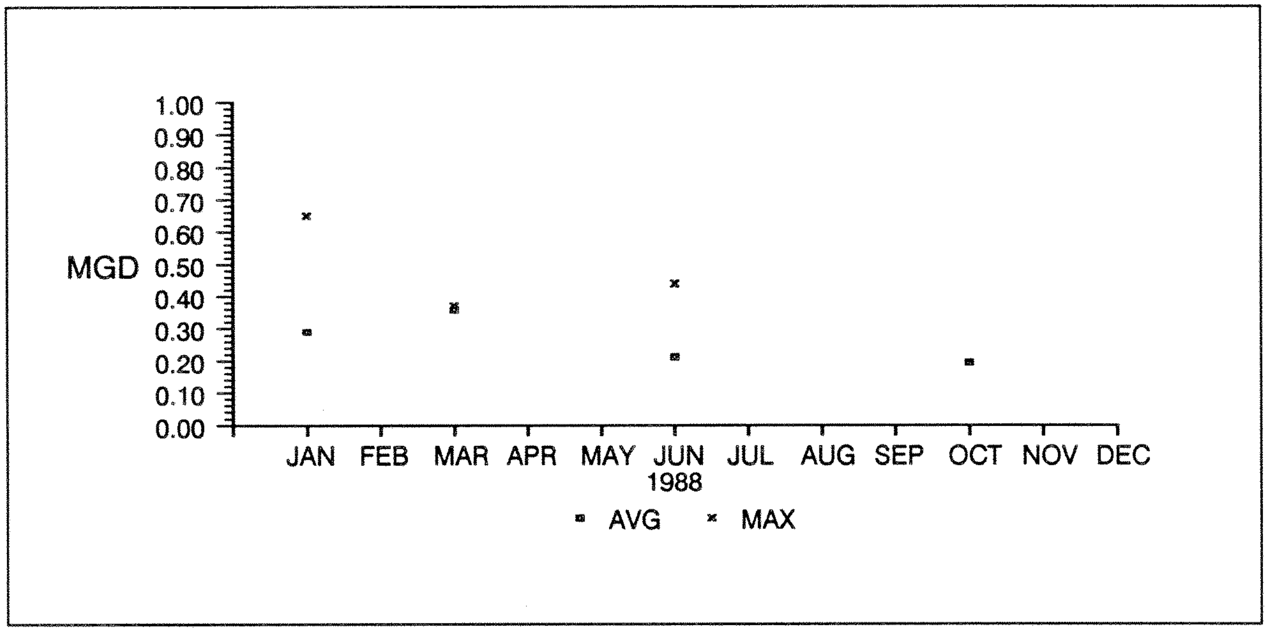

Figure C-5.26 Discharge Rate (MGD), Outfall 001.

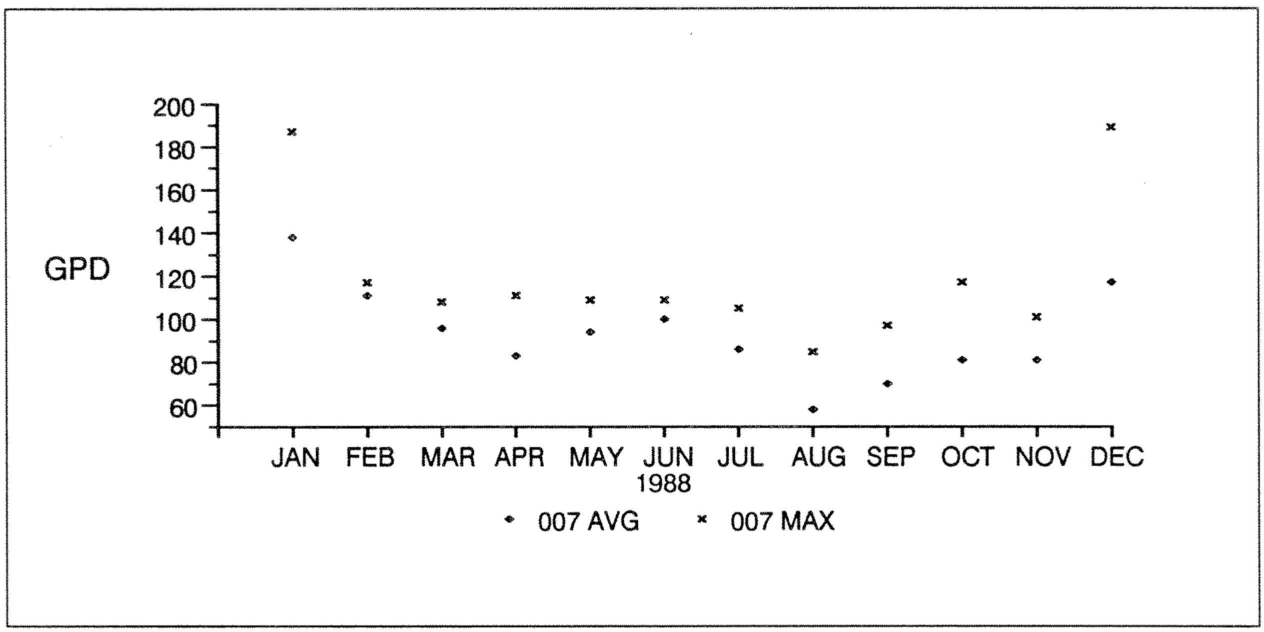

Figure C-5.27 Discharge Rate (GPD x 1,000), Outfall 007.

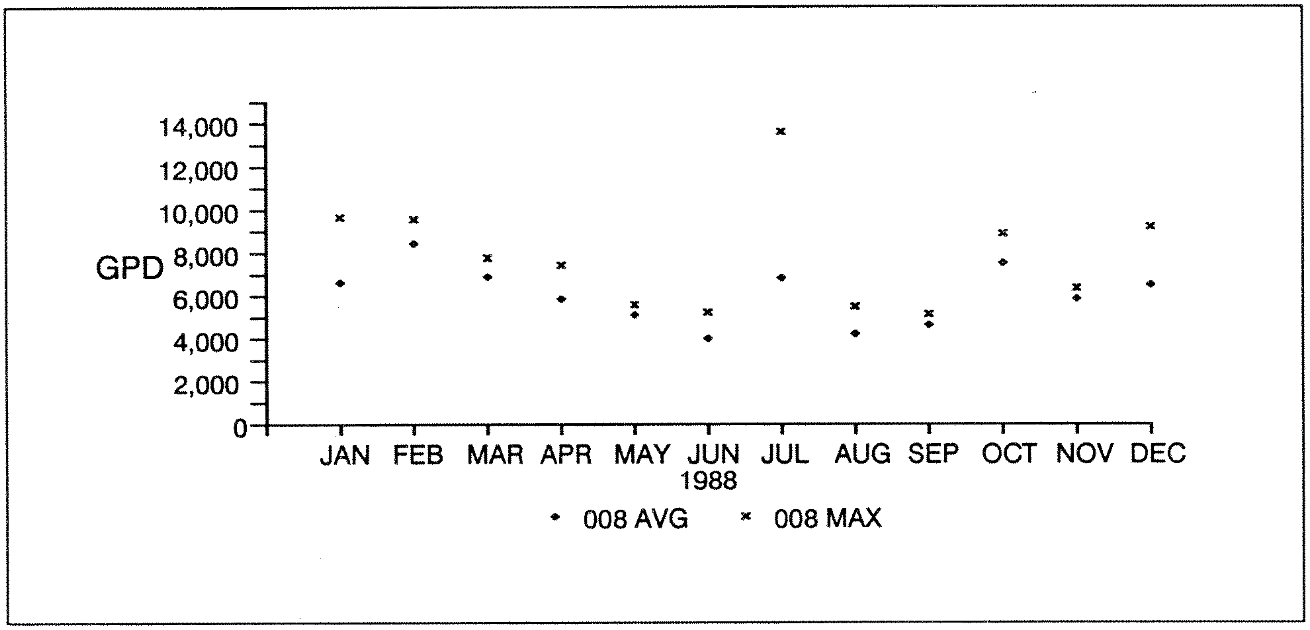

Figure C-5.28 Discharge Rate (GPD), Outfall 008.

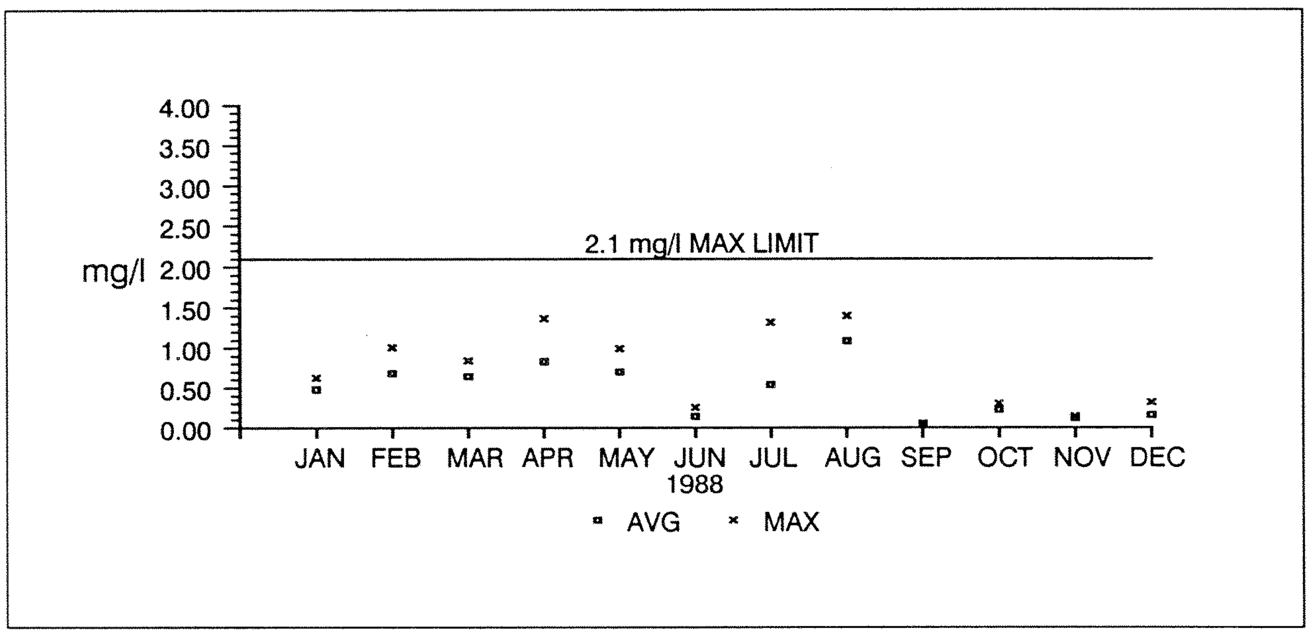

Figure C-5.29 Flow Weighted Averages - Ammonia, Outfalls 001 and 007.

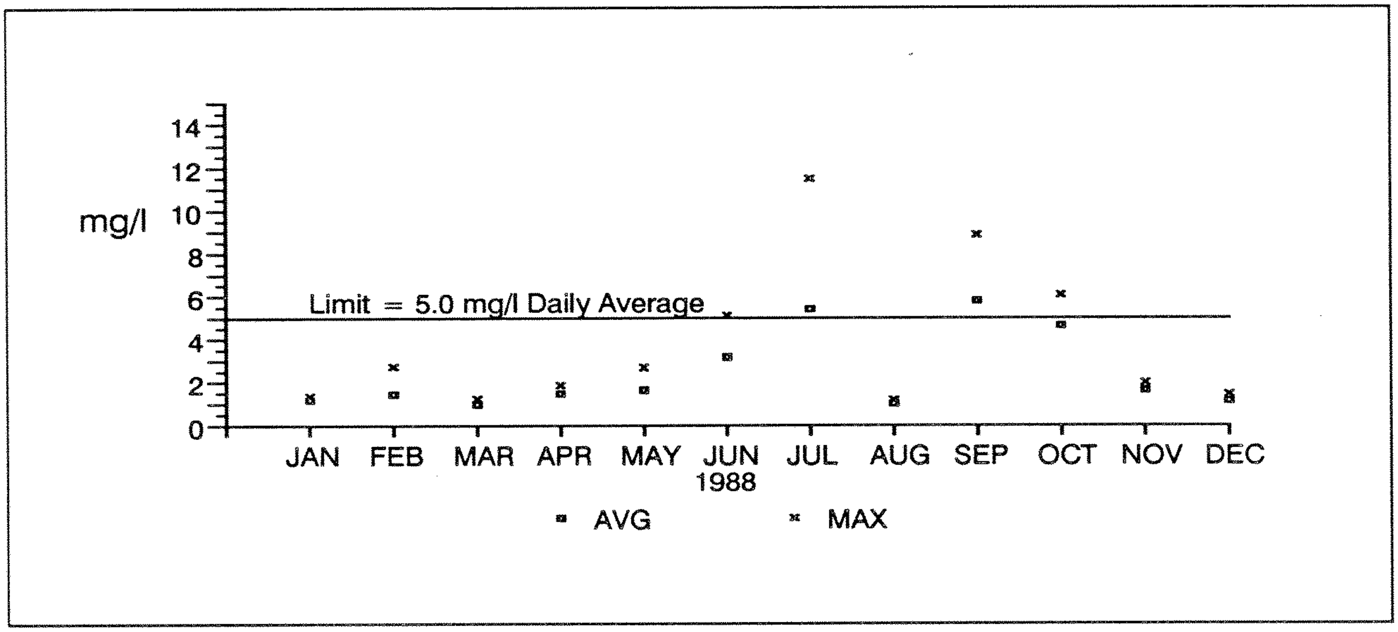

Figure C-5.30 Flow Weighted Averages, BOD-5, Outfalls 001, 007 and 008.

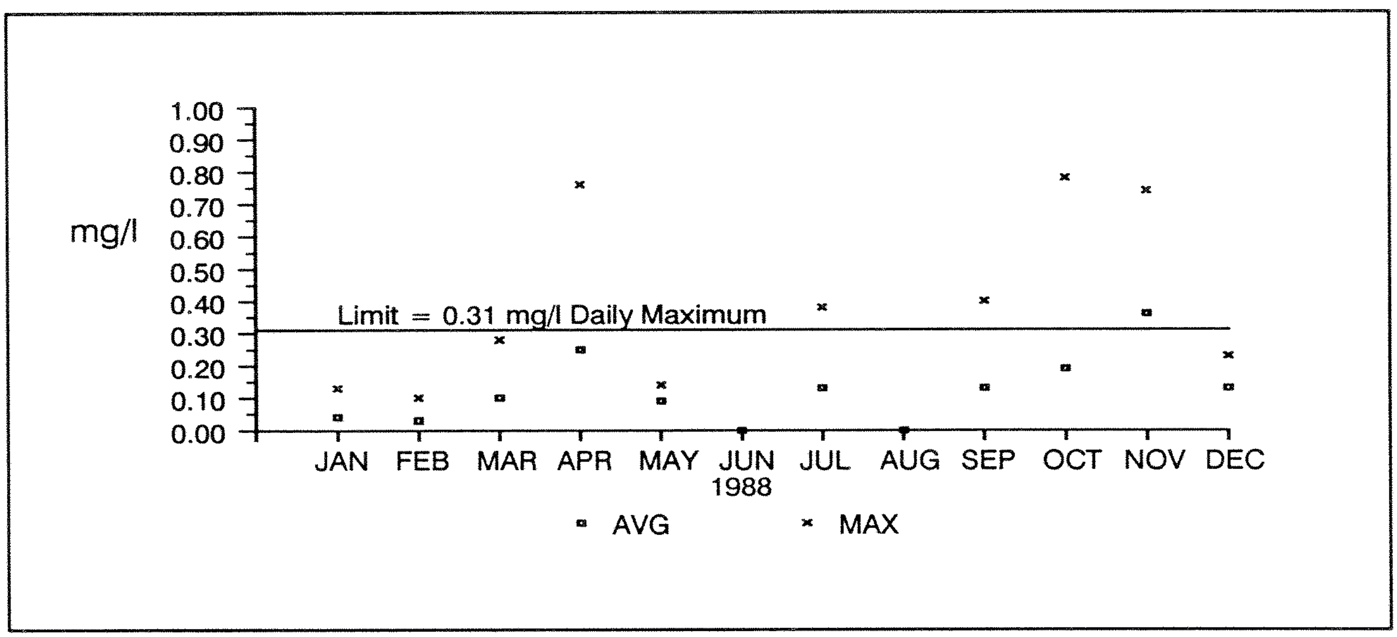

Figure C-5.31 Flow Weighted Averages, Iron (Fe), Outfalls 001, 007 and 008.

APPENDIX D
SUMMARY OF QUALITY ASSURANCE CROSS-CHECK ANALYSES

Table D-1.1
Comparison of Radiological Concentrations in Quality
Assurance Samples Between WVDP and EML for QAP 8803 Samples

Sample	Isotope	Actual	Reported	Ratio Rep/Act	Accept
air	Be-7	4.73E+03	4.54E+03	0.96	yes
air	Mn-54	3.63E+02	3.72E+02	1.02	yes
air	Co-57	1.62E+02	1.66E+02	1.02	yes
air	Co-60	2.82E+02	2.80E+02	0.99	yes
air	Sr-90	4.91E+00	4.94E+00	1.01	yes
air	Cs-134	3.81E+02	3.48E+02	0.91	yes
air	Cs-137	2.11E+02	2.32E+02	1.10	yes
air	Pu-239	2.52E+00	2.58E+00	1.02	yes
air	Am-241	3.02E+00	3.02E+00	1.00	yes
air	U-238	2.53E+00	2.72E+00	1.08	yes
air	U-ug	7.32E+00	8.13E+00	1.11	yes
soil	K-40	6.00E-01	8.25E-01	1.38	pass
soil	Sr-90	1.46E-01	1.52E-01	1.04	yes
soil	Cs-137	4.00E-01	3.83E-01	0.96	yes
soil	Pu-239	4.10E-02	7.66E-02	1.87	no
soil	Am-241	6.70E-03	7.35E-03	1.10	yes
soil	U-238	6.90E-01	5.66E-01	0.82	yes
soil	U-ug	1.97E+00	1.70E+00	0.86	yes
vegetn	K-40	3.60E+01	4.22E+01	1.17	yes
vegetn	Sr-90	1.09E+01	1.02E+01	0.94	yes
vegetn	Cs-137	4.62E+00	5.07E+00	1.10	yes
vegetn	Pu-239	4.50E-02	5.64E-02	1.25	pass
vegetn	Am-241	4.60E-02	3.77E-02	0.82	yes
vegetn	U-238	3.60E-02	3.80E-02	1.06	yes
vegetn	U-ug	1.04E-01	1.14E-01	1.10	yes
water	H-3	2.07E+01	2.63E+01	1.27	pass
water	Mn-54	6.80E+00	6.91E+00	1.02	yes
water	Co-57	2.50E+00	1.91E+00	0.76	pass
water	Co-60	2.03E+00	1.82E+00	0.90	yes
water	Sr-90	5.30E-01	5.70E-01	1.08	yes
water	Cs-134	3.56E+00	3.02E+00	0.85	yes
water	Cs-137	1.84E+00	1.73E+00	0.94	yes
water	Pu-239	2.43E-02	1.94E-02	0.80	yes
water	Am-241	4.10E-03	3.95E-03	0.96	yes
water	U-238	4.25E-03	4.47E-03	1.05	yes
water	U-ug	1.23E-02	1.34E-02	1.09	yes

Ratio: 1.2 - 0.8 acceptable; 1.5 - 0.5 pass

Table D-1.2

Comparison of Radiological Parameters in Quality Assurance Samples Between WVDP and EMSL (USEPA) in 1988

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
Gamma(water)	Cs-137	9.40E+01	1.12E+02	1.20	no
Feb 88	Cs-134	6.40E+01	5.43E+01	0.85	no
	Ru-106	1.05E+02	< DETECT	0.00	NA
	Zn-65	9.40E+01	1.37E+02	1.45	no
	Co-60	6.90E+01	7.93E+01	1.15	no
Gamma(water)	Cs-137	2.50E+01	3.27E+01	1.31	yes
Jun 88	Cs-134	2.00E+01	2.13E+01	1.07	yes
	Ru-106	1.95E+02	1.88E+02	0.96	yes
	Zn-65	1.01E+02	1.01E+02	1.00	yes
	Co-60	1.50E+01	1.83E+01	1.22	yes
HTO Feb 88	H-3	3.33E+03	3.13E+03	0.94	yes
HTO Jun 88	H-3	5.57E+03	4.89E+03	0.88	yes
A/B (water)	Beta	1.30E+01	1.40E+01	1.08	yes
Mar 88	Alpha	6.00E+00	3.00E+00	0.50	yes
A/B (water)	Beta	1.00E+01	1.40E+01	1.40	yes
Sep 88	Alpha	8.00E+00	5.33E+00	0.67	yes
Air Filter	Cs-137	1.60E+01	2.33E+01	1.46	yes
Mar 88	Sr-90	1.70E+01	1.57E+01	0.92	yes
	Beta	5.00E+01	5.77E+01	1.15	yes
	Alpha	2.00E+01	2.17E+01	1.08	yes
Air Filter	Cs-137	1.20E+01	1.30E+01	1.08	yes
Aug 88	Sr-90	8.00E+00	7.00E+00	0.88	yes
	Beta	2.90E+01	3.10E+01	1.07	yes
	Alpha	8.00E+00	8.33E+00	1.04	yes
Milk	Potassium	1.60E+03	1.67E+03	1.05	yes
Jun 88	Cs-137	5.10E+01	5.63E+01	1.10	yes
	I-131	9.40E+01	1.03E+02	1.09	yes
	Sr-89	4.00E+01	5.20E+01	1.30	no
	Sr-90	6.00E+01	7.83E+01	1.31	no
Milk	Potassium	1.60E+03	1.80E+03	1.13	no
Oct 88	Cs-137	5.00E+01	5.17E+01	1.03	yes
	I-131	9.10E+01	9.57E+01	1.05	yes
	Sr-89	4.00E+01	2.73E+01	0.68	no
	Sr-90	6.00E+01	5.47E+01	0.91	no
Perf. Eval.	Cs-137	7.00E+00	8.67E+00	1.24	yes
Apr 88	Cs-134	7.00E+00	1.07E+01	1.52	yes
	Co-60	5.00E+01	4.90E+01	0.98	yes
	Sr-90	5.00E+00	5.00E+00	1.00	yes
	Sr-89	5.00E+00	6.00E+00	1.20	yes
	Beta	5.70E+01	5.13E+01	0.90	yes
	U(nat)	6.00E+00	6.33E+00	1.06	yes
	Ra-228	5.60E+00	3.70E+00	0.66	no
	Ra-226	6.40E+00	4.00E+00	0.63	no
	Alpha	4.60E+01	3.47E+01	0.75	yes

Table D-1.2

Comparison of Radiological Parameters in Quality Assurance Samples Between WVDP and EMSL (USEPA) in 1988 (contd)

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
Perf. Eval.	Cs-137	1.50E+01	1.20E+01	0.80	yes
Oct 88	Cs-134	1.50E+01	1.30E+01	0.87	yes
	Sr-90	1.00E+01	9.67E+00	0.97	yes
	Sr-89	1.10E+01	9.67E+00	0.88	yes
	Beta	5.40E+01	5.40E+01	1.00	yes
	U(nat)	5.00E+00	5.00E+00	1.00	yes
	Ra-228	5.20E+00	5.17E+00	0.99	yes
	Ra-226	5.00E+00	5.50E+00	1.10	yes
	Alpha	4.10E+01	3.10E+01	0.76	yes
Plut.(water)	Pu-239	1.02E+01	9.83E+00	0.96	yes

Note: Acceptable range determined by EPA-EMSL

Table D-1.3

Comparison of Radiological Concentrations in Quality Assurance Samples Between WVDP and NBS for 1988 INEL QA Samples

Sample	INEL QA 23 Isotope	Gamma in Water NBS Measured	WV Reported	Ratio WV/NBS	Accept
water	Ce-144	1.73E-02	2.26E-02	1.31	no
water	Ce-141	2.02E-02	2.48E-02	1.23	no
water	Cr-51	1.15E-01	9.35E-02	0.81	no
water	Cs-134	2.53E-02	2.08E-02	0.82	no
water	Cs-137	2.07E-02	2.08E-02	1.00	yes
water	Co-58	1.29E-02	1.21E-02	0.94	no
water	Mn-54	6.05E-03	5.72E-03	0.95	yes
water	Fe-59	2.48E-02	2.50E-02	1.01	yes
water	Zn-65	3.25E-02	3.23E-02	0.99	yes
water	Co-60	1.07E-02	1.10E-02	1.03	yes

Note: Acceptable range is 1.00 ± 0.05 ratio.

Table D-1.4
Comparison of Water Quality Parameters in Quality Assurance Samples
Between WVDP and NYSDOH, JAN 1988

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Ag	74.7	80.0	1.07	yes
water	Ag	360.0	355.0	0.99	yes
water	Al	123.5	120.0	0.97	yes
water	Al	308.0	311.0	1.01	yes
water	As	97.1	102.0	1.05	yes
water	As	390.1	407.0	1.04	yes
water	BOD-5	87.2	99.0	1.14	yes
water	BOD-5	24.8	26.8	1.08	yes
water	CN	1.0	0.9	0.92	yes
water	CN	2.0	1.7	0.85	yes
water	Cd	19.9	22.0	1.11	yes
water	Cd	75.2	77.0	1.02	yes
water	Cr	79.4	83.0	1.05	yes
water	Cr	347.0	357.0	1.03	yes
water	Cu	60.3	61.0	1.01	yes
water	Cu	251.3	249.0	0.99	yes
water	Fe	162.6	159.0	0.98	yes
water	Fe	443.4	443.0	1.00	yes
water	NH-3(as N)	3.4	3.4	1.00	yes
water	NH-3(as N)	2.0	1.9	0.97	yes
water	Ni	125.1	128.0	1.02	yes
water	Ni	344.2	348.0	1.01	yes
water	Pb	132.8	133.0	1.00	yes
water	Pb	439.2	456.0	1.04	yes
water	pH	7.4	7.4	1.00	yes
water	pH	5.1	5.1	1.00	yes
water	Sus Solids	43.1	43.7	1.01	yes
water	Sus Solids	14.1	12.7	0.90	yes
water	Se	90.9	101.0	1.11	yes
water	Se	181.3	209.0	1.15	yes
water	Zn	593.3	592.0	1.00	yes
water	Zn	3999.8	3921.0	0.98	yes

Table D-1.5
Comparison of Water Quality Parameters in Quality Assurance Samples
Between WVDP and NYSDOH, JUN 1988

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Ag	59.0	53.7	0.91	yes
water	Ag	392.7	400.0	1.02	yes
water	Al	408.3	396.0	0.97	yes
water	Al	111.5	105.0	9.94	yes
water	As	81.6	75.3	0.92	yes
water	As	367.1	367.0	1.00	yes
water	Cd	33.5	33.2	0.99	yes
water	Cd	60.0	57.2	0.95	yes
water	BOD-5	25.4	23.1	0.91	yes
water	BOD-5	77.2	72.6	0.94	yes
water	CN	0.9	87.7	97.44	no
water	CN	1.9	186.0	97.89	no
water	Cr	417.4	408.0	0.98	yes
water	Cr	71.6	67.9	0.95	yes
water	Cu	57.4	56.7	0.99	yes
water	Cu	375.4	373.0	0.99	yes
water	Fe	60.9	58.0	0.95	yes
water	Fe	299.7	299.0	1.00	yes
water	NH-3(as N)	4.7	4.7	1.00	yes
water	NH-3(as N)	2.2	2.2	1.00	yes
water	Ni	170.5	175.0	1.03	yes
water	Ni	481.0	487.0	1.01	yes
water	Oil&Grease	133.4	144.0	1.08	yes
water	Oil&Grease	61.8	67.3	1.09	yes
water	Pb	217.9	218.0	1.00	yes
water	Pb	125.7	124.0	0.99	yes
water	pH	5.5	5.5	1.00	yes
water	pH	7.3	7.4	1.01	yes
water	Sus Solids	20.9	20.5	0.98	yes
water	Sus Solids	58.0	58.0	1.00	yes
water	Se	84.9	84.4	0.99	yes
water	Se	138.9	136.0	0.98	yes
water	Zn	3278.0	3275.0	1.00	yes
water	Zn	767.4	776.0	1.01	yes

Note: Aceptable range determined by NYSDOH

Table D-1.6
Comparison of Water Quality Parameters in Quality Assurance Samples
Between WVDP and USEPA, JULY 1988

Sample	Analyte	Actual	Reported	Ratio Rep/Act	Accept
water	Al	626	620	0.99	yes
water	As	111	109	0.98	yes
water	Cd	270	270	1.00	yes
water	Cr	89.2	95	1.07	yes
water	Co	382	417	1.09	yes
water	Cu	100	102	1.02	yes
water	Fe	763	763	1.00	yes
water	Pb	914	963	1.05	yes
water	Mn	860	850	0.99	yes
water	Ni	171	178	1.04	yes
water	Se	82.1	82	1.00	yes
water	Zn	1270	1307	1.03	yes
water	pH	6.30	6.29	1.00	yes
water	Sus Solids	34.8	32.1	0.92	yes
water	Oil & Grease	21.0	21.5	1.02	yes
water	NH-3(as N)	10.3	10.0	0.97	yes
water	BOD-5	66.4	73.0	1.10	yes

Note: Acceptable range determined by USEPA

Table D-1.7

Comparison of WVDP to NRC Co-located Environmental TLD Dosimeters in WVDP Environs

FIRST QTR TLD 1988

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	7.8	8.3	1.06	yes
3	5	8.0	7.9	0.99	yes
4	7	6.9	7.4	1.07	yes
5	9	8.5	7.9	0.93	yes
7	14	9.0	8.8	0.98	yes
8	15	8.5	8.8	1.04	yes
9	25	16.8	17.6	1.05	yes
11	24	674.0	911.0	1.35	pass

SECOND QTR TLD 1988

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	9.0	9.7	1.08	yes
3	5	10.5	10.2	0.97	yes
4	7	7.7	9.3	1.21	pass
5	9	10.7	9.3	0.87	yes
7	14	8.8	10.2	1.16	yes
8	15	8.5	9.7	1.14	yes
9	25	19.6	16.7	0.85	yes
11	24	626.0	753.0	1.20	yes

THIRD QTR TLD 1988

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	7.9	10.2	1.29	pass
3	5	8.9	11.1	1.25	pass
4	7	7.5	10.2	1.36	pass
5	9	8.9	9.9	1.11	yes
7	14	8.8	11.6	1.32	pass
8	15	9.0	10.6	1.18	yes
9	25	16.9	18.1	1.07	yes
11	24	611.0	733.0	1.20	yes

FOURTH QTR TLD 1988

NRC TLD #	WVDP TLD #	µR/hr NRC	µR/hr WVDP	WV/NRC	Accept
2	22	8.6	9.7	1.13	yes
3	5	14.0	11.6	0.83	yes
4	7	8.3	11.1	1.34	pass
5	9	10.4	9.7	0.93	yes
7	14	8.9	11.6	1.30	pass
8	15	8.5	10.6	1.25	pass
9	25	18.5	17.6	0.95	yes
11	24	724.0	756.0	1.04	yes

Ratio: 1.2 - 0.8 acceptable; 1.5 - 0.5 pass

APPENDIX E
SUMMARY OF GROUNDWATER MONITORING

TABLE E-1
SUPPORTING GROUNDWATER MONITORING STATIONS
SAMPLED DURING 1988

LOCATION CODE	PERIOD SAMPLED*	pH	CONDUCTIVITY @ 25°C (μmhos/cm)	ALPHA	BETA	Tritium	Cs-137
				WELLS NEAR SITE FACILTIES			
WNW80-03	8810	7.30	638	<5.41 E-09	2.93 E-07 ± 1.43 E-08	<1.24 E-07	<4.2 E-08
WNW80-03	8820	7.62	292	<1.06 E-09	1.23 E-07 ± 6.41 E-09	<1.0 E-07	<3.7 E-08
WNW80-04	8810	7.08	556	<2.09 E-09	1.09 E-08 ± 2.67 E-09	2.28 E-07 ± 1.36 E-07	<3.7 E-08
WNW80-04	8820	7.35	548	<1.53 E-09	1.06 E-08 ± 2.62 E-09	<1.18 E-07	<3.7 E-08
				WELLS NEAR NRC DISPOSAL UNIT			
WNW82-1A	8810	7.23	1223	1.16 E-08 ± 7.69 E-09	3.64 E-09 ± 2.38 E-09	3.66 E-07 ± 1.24 E-07	<3.7 E-08
WNW82-1A	8820	7.45	1325	<2.66 E-09	2.63 E-09 ± 2.30 E-09	1.41 E-07 ± 1.22 E-07	<3.7 E-08
WNW82-1B	8810	7.35	1439	<4.03 E-09	7.42 E-09 ± 2.68 E-09	<1.18 E-07	<3.7 E-08
WNW82-1B	8820	7.27	1460	<5.17 E-09	7.61 E-09 ± 2.78 E-09	<1.18 E-07	<3.7 E-08
WNW82-1C	8810	7.78	418	5.81 E-09 ± 5.67 E-09	2.27 E-09 ± 2.23 E-09	<1.0 E-07	<3.7 E-08
WNW82-1C	8820	7.76	400	6.75 E-09 ± 5.95 E-09	3.65 E-09 ± 2.34 E-09	<1.0 E-07	<3.7 E-08
WNW82-2B	8810	7.42	764	5.28 E-09 ± 5.15 E-09	5.12 E-09 ± 2.40 E-09	<1.0 E-07	<3.7 E-08
WNW82-2B	8820	7.33	752	<6.11 E-09	6.42 E-09 ± 2.69 E-09	<1.0 E-07	<3.7 E-08
WNW82-2C	8810	9.23	718	7.80 E-09 ± 5.86 E-09	<3.61 E-09	<1.0 E-07	N/A
WNW82-2C	8820	9.28	667	<6.34 E-09	<3.83 E-09	<1.0 E-07	<4.2 E-08
WNW82-3A	8810	7.62	446	***NOT AVAILABLE***		<1.0 E-07	N/A
WNW82-3A	8820	7.86	374	3.74 E-09 ± 2.81 E-09	5.85 E-09 ± 2.19 E-09	<1.0 E-07	<3.7 E-08
WNW82-4A1	8810	6.90	1332	<5.74 E-09	3.70 E-09 ± 2.49 E-09	5.54 E-05 ± 1.69 E-06	<3.7 E-08
WNW82-4A1	8820	7.18	1383	<7.14 E-09	<2.48 E-09	6.02 E-05 ± 1.83 E-06	<3.7 E-08
WNW82-4A2	8810	6.85	1515	<3.24 E-09	<1.99 E-09	<1.21 E-07	<3.7 E-08
WNW82-4A2	8820	6.91	1488	<5.38 E-09	<2.48 E-09	1.37 E-07 ± 1.19 E-07	<3.7 E-08
WNW82-4A3	8810	6.86	1423	<5.28 E-09	5.06 E-09 ± 2.84 E-09	<1.0 E-07	<3.7 E-08
WNW82-4A3	8820	7.12	1410	<4.06 E-09	<2.54 E-09	<1.22 E-07	<3.7 E-08

* Periods sampled: 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-2
1988 FUEL TANK GROUNDWATER MONITORING

PARAMETER	WNW86-13 8801*	WNW86-13 8810*	WNW86-13 8820*
pH	6.94	6.96	7.06
Conductivity (µmhos/cm @25C)	721	680	623
TOC (mg/L)	3.30	1.80	5.00
Phenols (mg/L)	<0.01	<0.01	<0.01
Benzene (µg/L)	<0.2	<1	<1
Toluene (µg/L)	<0.2	<1	<1
o-xylene (µg/L)	<0.2	<2	<1
m-xylene (µg/L)	<0.2	<1	<1
p-xylene (µg/L)	<0.2	<1	<1
Tritium (µci/mL)	<1.0 E-07	<1.0 E-07	<1.0 E-07
Alpha (µci/mL)	<5.30 E-09	<3.34 E-09	<2.71 E-09
Beta (µCi/mL)	1.16 E-08 ± 2.84 E-09	7.68 E-09 ± 2.38 E-09	<1.81 E-09

* Periods sampled: 8801, 1st Quarter; 8810, 1st Semiannual;
8820, 2nd Semiannual.

TABLE E-3
1988 WATER QUALITY PARAMETERS FOR
HIGH-LEVEL WASTE TANK COMPLEX
GROUNDWATER MONITORING UNIT

LOCATION CODE	PERIOD SAMPLED*	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	mg/L TOC	PHENOL	TOX	CHLORIDE	NITRATE-N	SULFATE	FLUORIDE
WNW80-02	8801	7.76	359	1.0	<0.01	N/A	36.0	0.67	10	<0.10
WNW80-02	8810	7.60	370	3.0	<0.01	<0.010	35.0	0.32	43	<0.10
WNW80-02	8820	7.94	374	1.1	<0.01	<0.010	38.3	0.60	22	<0.10
WNDMPNE**	8801	6.91	526	2.8	<0.01	N/A	50.0	1.58	48	<0.10
WNDMPNE	8810	6.83	667	1.1	<0.01	0.013	76.5	0.80	50	<0.10
WNDMPNE	8820	6.91	582	4.2	<0.01	<0.010	46.0	0.82	66	<0.10
WNW86-07	8801	6.85	810	1.1	<0.01	N/A	5.6	1.30	185	<0.10
WNW86-07	8810	6.96	870	<1.0	<0.01	0.003	9.7	0.81	188	<0.10
WNW86-07	8820	6.47	823	2.0	<0.01	0.011	9.2	0.44	153	<0.10
WNW86-08	8801	6.53	629	3.4	<0.01	N/A	23.8	0.05	135	<0.10
WNW86-08	8810	7.05	734	<1.0	<0.01	0.015	20.5	0.10	140	<0.10
WNW86-08	8820	6.83	657	4.3	<0.01	0.013	9.4	0.09	160	<0.10
WNW86-09	8801	7.03	732	1.8	<0.01	N/A	98.0	1.88	31	<0.10
WNW86-09	8810	7.28	653	<1.0	<0.01	0.017	35.8	1.30	46	<0.10
WNW86-09	8820	7.38	593	1.2	<0.01	0.005	30.5	2.68	29	<0.10
WNW86-12**	8801	7.66	596	11.5	<0.01	N/A	32.0	0.12	53	<0.10
WNW86-12	8810	7.61	591	<1.0	<0.01	0.010	41.0	0.06	65	<0.10
WNW86-12	8820	7.56	615	7.2	<0.01	<0.010	40.0	0.06	50	<0.10

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

** Monitoring wells near former cold dump.

TABLE E-4

1988 TOTAL METALS FOR

HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX

GROUNDWATER MONITORING UNIT

(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW80-02	8801	<0.005	0.07	<0.005	0.004	0.65	<0.060	0.03	<0.0005	<0.005	<0.005	<5.0
WNW80-02	8810	<0.005	0.10	0.009	<0.007	1.15	0.016	0.06	<0.0005	<0.005	<0.005	7.0
WNW80-02	8820	<0.005	0.09	<0.010	0.006	1.30	<0.005	0.07	<0.0004	<0.005	<0.010	4.3
WNDMPNE**	8801	<0.005	0.08	<0.005	<0.005	0.18	<0.020	0.13	<0.0005	<0.005	<0.005	12.3
WNDMPNE	8810	<0.005	0.13	0.006	<0.007	0.17	0.010	0.04	<0.0005	<0.005	<0.005	21.8
WNDMPNE	8820	<0.005	0.10	0.006	<0.020	3.78	<0.005	0.13	<0.0004	<0.005	<0.010	15.8
WNW86-07	8801	<0.005	0.07	<0.005	0.005	0.98	0.030	0.10	0.0034	<0.005	<0.005	11.0
WNW86-07	8810	0.005	0.06	0.012	0.009	2.80	0.016	0.36	<0.0005	<0.005	<0.005	9.0
WNW86-07	8820	<0.005	0.06	<0.010	0.026	0.95	<0.005	0.61	<0.0004	<0.005	<0.010	20.0
WNW86-08	8801	<0.005	0.08	<0.005	<0.005	0.75	<0.030	7.78	<0.0002	<0.005	<0.005	7.0
WNW86-08	8810	<0.005	0.09	0.011	0.008	2.48	0.042	2.60	<0.0008	<0.005	<0.005	8.0
WNW86-08	8820	0.008	0.11	<0.010	0.021	8.33	0.005	5.13	<0.0004	<0.005	<0.010	10.3
WNW86-09	8801	<0.005	0.23	<0.005	0.005	2.15	<0.030	0.13	0.0024	<0.005	<0.005	8.0
WNW86-09	8810	0.008	0.24	0.011	0.016	11.75	0.012	0.36	<0.0005	<0.005	<0.005	7.8
WNW86-09	8820	<0.005	0.16	<0.010	0.008	3.95	<0.005	0.13	<0.0004	<0.005	0.010	6.1
WNW86-12**	8801	<0.005	0.32	<0.005	<0.005	0.28	<0.030	0.08	<0.0002	<0.005	<0.005	11.8
WNW86-12	8810	0.005	0.31	0.008	0.005	0.31	0.009	0.09	<0.0005	<0.005	<0.005	12.0
WNW86-12	8820	0.004	0.32	<0.010	0.027	1.58	<0.005	0.10	<0.0004	<0.005	<0.010	12.3

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

** Monitoring wells near former cold dump.

TABLE E-5
1988 DISSOLVED METALS FOR
HIGH-LEVEL RADIOACTIVE WASTE TANK COMPLEX
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW80-02	8801	<0.005	0.09	<0.005	<0.005	<0.03	<0.060	0.02	<0.0005	<0.005	<0.005	<5.0
WNW80-02	8810	<0.005	0.12	<0.006	<0.007	0.002	<0.005	0.05	<0.0005	<0.005	<0.005	5.1
WNW80-02	8820	<0.005	0.07	<0.010	<0.005	0.02	<0.005	0.04	<0.0004	<0.005	<0.010	4.0
WNDMPNE**	8801	<0.005	0.08	<0.005	<0.005	0.05	<0.020	0.11	<0.0005	<0.005	<0.005	11.8
WNDMPNE	8810	<0.005	0.13	<0.006	<0.007	0.02	<0.005	0.02	<0.0005	<0.005	<0.005	22.0
WNDMPNE	8820	<0.005	0.09	<0.010	0.020	0.04	<0.005	0.02	<0.0004	<0.005	0.010	13.8
WNW86-07	8801	<0.005	0.06	<0.005	<0.005	<0.02	<0.030	0.05	<0.0002	<0.005	<0.005	9.5
WNW86-07	8810	<0.005	0.05	0.008	0.005	<0.03	<0.005	0.04	<0.0005	<0.005	<0.005	7.8
WNW86-07	8820	<0.005	0.07	<0.010	<0.02	0.05	<0.005	0.42	<0.0004	<0.005	<0.010	17.3
WNW86-08	8801	<0.005	0.08	<0.005	<0.005	0.72	<0.030	7.73	<0.0002	<0.005	<0.005	6.0
WNW86-08	8810	<0.005	0.09	0.007	<0.005	0.09	<0.005	2.80	<0.0008	<0.005	<0.005	6.8
WNW86-08	8820	<0.005	0.10	<0.010	<0.20	0.82	0.005	5.95	<0.0004	<0.005	<0.010	7.0
WNW86-09	8801	<0.005	0.20	<0.005	<0.005	0.05	<0.030	0.002	<0.0002	<0.005	<0.005	7.0
WNW86-09	8810	<0.005	0.15	0.006	0.006	<0.04	<0.005	0.01	<0.0005	<0.005	<0.005	6.3
WNW86-09	8820	<0.005	0.18	<0.010	<0.005	<0.04	<0.005	0.01	<0.0004	<0.005	<0.010	5.9
WNW86-12**	8801	<0.005	0.32	<0.005	<0.005	0.19	<0.030	0.08	<0.0002	<0.005	<0.005	11.3
WNW86-12	8810	<0.005	0.28	0.005	<0.005	0.29	<0.005	0.09	<0.0005	<0.005	<0.005	11.3
WNW86-12	8820	<0.005	0.32	<0.010	0.020	0.26	<0.005	0.09	<0.0004	<0.005	<0.010	13.0

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

** Monitoring wells near former cold dump.

TABLE E-6
1988 RADIOACTIVITY CONCENTRATIONS FOR
GROUNDWATER IN HIGH-LEVEL RADIOACTIVE WASTE TANK
COMPLEX MONITORING UNIT
(μCi/mL)

LOCATION CODE	PERIOD SAMPLED*	ALPHA	BETA	Tritium	Cs-137	Co-60
WNW80-02	8801	<8.70 E-10	<8.40 E-10	<1.00 E-07	<1.08 E-07	<1.09 E-07
WNW80-02	8810	<7.10 E-10	2.22 E-09 ± 8.90 E-10	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW80-02	8820	<7.57 E-10	<8.08 E-10	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNDMPNE**	8801	<9.22 E-10	1.55 E-07 ± 3.67 E-09	8.55 E-07 ± 6.50 E-08	<1.08 E-07	<1.09 E-07
WNDMPNE	8810	<9.13 E-10	8.95 E-08 ± 2.91 E-09	1.15 E-06 ± 6.88 E-08	<3.05 E-08	<3.20 E-08
WNDMPNE	8820	<1.27 E-09	1.12 E-07 ± 3.21 E-09	8.68 E-07 ± 7.96 E-08	<3.05 E-08	<3.20 E-08
WNW86-07	8801	<1.32 E-09	8.84 E-09 ± 1.25 E-09	<5.14 E-08	<1.08 E-07	<1.09 E-07
WNW86-07	8810	3.01 E-09 ± 1.87 E-09	7.02 E-09 ± 1.21 E-09	2.54 E-07 ± 5.79 E-08	<3.05 E-08	<3.20 E-08
WNW86-07	8820	<1.24 E-09	6.52 E-09 ± 1.16 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-08	8801	<7.74 E-10	8.87 E-09 ± 1.21 E-09	4.20 E-07 ± 8.95 E-08	<1.08 E-07	<1.09 E-07
WNW86-08	8810	3.87 E-09 ± 1.91 E-09	7.79 E-09 ± 1.21 E-09	5.37 E-06 ± 1.26 E-07	<3.05 E-08	<3.20 E-08
WNW86-08	8820	<1.36 E-09	9.86 E-09 ± 1.24 E-09	2.19 E-06 ± 1.03 E-07	<3.05 E-08	<3.20 E-08
WNW86-09	8801	2.74 E-09 ± 2.07 E-09	1.71 E-07 ± 4.06 E-09	2.24 E-06 ± 8.14 E-08	<1.08 E-07	<1.09 E-07
WNW86-09	8810	9.36 E-09 ± 3.20 E-09	1.87 E-07 ± 4.34 E-09	2.44 E-06 ± 8.54 E-08	<3.05 E-08	<3.20 E-08
WNW86-09	8820	<1.05 E-09	1.70 E-07 ± 3.93 E-09	1.85 E-06 ± 9.18 E-08	<3.05 E-08	<3.20 E-08
WNW86-12**	8801	<1.01 E-09	9.25 E-10 ± 8.86 E-10	4.95 E-06 ± 1.18 E-07	<1.08 E-07	<1.09 E-07
WNW86-12	8810	<8.78 E-10	9.26 E-10 ± 8.64 E-10	4.10 E-06 ± 1.06 E-07	<3.05 E-08	<3.20 E-08
WNW86-12	8820	<1.02 E-09	1.49 E-09 ± 8.91 E-10	3.96 E-06 ± 1.24 E-07	<3.05 E-08	<3.20 E-08

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.
** Monitoring wells near former cold dump.

TABLE E-7
1988 WATER QUALITY PARAMETERS FOR
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT

LOCATION CODE	PERIOD SAMPLED*	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	mg/L TOC	PHENOL	TOX	CHLORIDE	NITRATE-N	SULFATE	FLUORIDE
WNW86-06	8801	6.69	1357	1.0	<0.01	N/A	345.0	0.15	29	<0.10
WNW86-06	8810	6.79	1360	<1.0	<0.01	0.012	317.5	0.16	32	<0.10
WNW86-06	8820	6.80	4018	2.0	<0.01	0.016	1150.0	0.09	37	<0.10
WNGSEEP	8801	6.34	449	<1.0	0.01	N/A	38.8	1.13	42	<0.10
WNGSEEP	8810	6.58	567	<1.0	<0.01	0.011	74.3	0.72	52	<0.10
WNGSEEP	8820	6.32	545	1.4	<0.01	0.010	46.0	0.93	50	<0.10
WNSP008	8801	7.12	897	0.9	0.01	N/A	78.0	1.78	73	<0.10
WNSP008	8810	6.89	998	1.5	<0.01	0.016	110.0	0.99	70	<0.10
WNSP008	8820	6.95	926	4.1	<0.01	0.011	77.8	0.83	85	<0.10
WNW80-05	8801	7.15	542	1.0	0.01	N/A	49.0	0.83	34	0.12
WNW80-05	8810	7.43	779	<1.0	<0.01	0.005	100.0	0.72	62	0.10
WNW80-05	8820	6.94	634	5.6	<0.01	<0.001	74.0	0.44	52	<0.10
WNW80-06	8801	6.22	698	<1.0	<0.01	N/A	36.0	0.11	130	<0.10
WNW80-06	8810	6.48	912	3.5	<0.01	0.070	26.8	0.15	200	<0.10
WNW80-06	8820	6.44	852	3.4	<0.01	<0.010	33.5	0.09	200	<0.10
WNW86-03	8801	7.52	849	<1.0	0.01	N/A	105.0	1.38	37	<0.10
WNW86-03	8810	7.06	788	<1.0	<0.01	0.010	99.5	1.10	42	<0.10
WNW86-03	8820	7.37	884	2.7	<0.01	0.008	127.5	1.23	35	<0.10
WNW86-04	8801	7.24	835	<1.0	<0.01	N/A	96.3	1.45	37	<0.10
WNW86-04	8810	6.98	786	<1.0	<0.01	0.010	100.3	1.00	46	<0.10
WNW86-04	8820	7.33	852	1.3	<0.01	0.015	122.5	1.33	36	<0.10
WNW86-05	8801	6.78	709	4.1	0.02	N/A	17.1	0.08	43	<0.10
WNW86-05	8810	6.79	946	12.9	<0.01	0.028	41.5	<0.10	70	0.25
WNW86-05	8820	6.98	641	8.5	<0.01	0.014	7.8	<0.10	58	0.09

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-8

1988 TOTAL METALS FOR

LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM

GROUNDWATER MONITORING UNIT

(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW86-06	8801	<0.005	0.075	<0.005	<0.005	0.16	0.030	3.18	<0.0002	<0.005	<0.005	140
WNW86-06	8810	0.017	0.051	0.010	<0.005	0.29	0.012	1.65	<0.0005	<0.005	<0.005	185
WNW86-06	8820	<0.005	0.180	<0.005	0.009	0.17	<0.005	4.78	<0.0004	<0.005	<0.010	633
WNGSEEP	8801	<0.005	0.100	<0.005	<0.005	0.08	<0.060	<0.01	<0.0005	<0.005	<0.005	12
WNGSEEP	8810	<0.005	0.130	0.009	0.005	1.68	0.004	0.04	<0.0008	<0.005	<0.005	15
WNGSEEP	8820	<0.005	0.120	0.007	0.010	1.45	<0.005	0.05	0.0006	<0.005	0.005	15
WNSP008	8801	<0.005	0.083	<0.005	<0.005	0.06	<0.020	2.30	<0.0005	<0.005	<0.005	43
WNSP008	8810	<0.005	0.110	0.010	<0.007	0.09	0.005	2.38	<0.0005	<0.005	<0.005	63
WNSP008	8820	<0.005	0.068	<0.010	<0.020	0.06	<0.005	2.10	<0.0004	<0.006	<0.010	51
WNW80-05	8801	<0.005	0.100	<0.005	0.004	2.75	<0.060	0.04	<0.0005	<0.005	<0.005	9
WNW80-05	8810	<0.005	0.095	0.013	<0.005	2.95	0.020	0.17	<0.0008	<0.005	<0.005	15
WNW80-05	8820	<0.005	0.095	<0.005	<0.010	1.23	<0.005	0.07	0.0051	<0.005	<0.010	19
WNW80-06	8801	<0.005	0.073	<0.005	<0.005	0.95	<0.060	9.75	<0.0005	<0.005	<0.005	14
WNW80-06	8810	0.005	0.075	<0.007	0.010	0.41	<0.005	9.30	<0.0002	<0.005	<0.010	18
WNW80-06	8820	<0.005	0.043	<0.010	0.020	0.50	0.008	5.55	<0.0004	<0.005	0.013	18
WNW86-03	8801	<0.005	0.210	<0.005	<0.005	<0.03	<0.060	< 0.01	<0.0005	<0.005	<0.005	23
WNW86-03	8810	<0.005	0.245	0.008	0.006	0.07	0.018	0.01	<0.0005	<0.005	<0.005	28
WNW86-03	8820	<0.005	0.195	<0.005	0.015	0.12	<0.005	0.01	<0.0004	<0.005	<0.010	28
WNW86-04	8801	<0.005	0.183	<0.005	<0.005	0.70	<0.060	0.04	<0.0005	<0.005	<0.005	22
WNW86-04	8810	<0.005	0.268	0.008	<0.007	3.30	0.017	0.08	<0.0005	<0.005	<0.005	29
WNW86-04	8820	<0.005	0.203	<0.005	0.009	1.05	<0.005	0.07	<0.0004	<0.005	<0.010	29
WNW86-05	8801	<0.200	0.104	<0.002	<0.020	3.80	<0.050	7.58	<0.0002	<0.200	<0.010	37
WNW86-05	8810	0.006	0.125	<0.002	<0.020	5.06	<0.050	10.85	<0.0002	<0.002	<0.010	70
WNW86-05	8820	0.006	0.100	<0.002	<0.020	3.50	<0.002	7.96	<0.0002	<0.002	<0.001	29

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-9
1988 DISSOLVED METALS FOR
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW86-06	8801	<0.005	0.08	<0.005	<0.005	<0.02	<0.030	3.20	<0.0002	<0.005	<0.005	120
WNW86-06	8810	<0.005	0.05	0.006	<0.005	<0.03	<0.005	1.60	<0.0005	<0.005	<0.005	188
WNW86-06	8820	<0.005	0.18	<0.010	<0.010	0.10	<0.005	4.68	<0.0004	<0.005	<0.010	648
WNGSEEP	8801	<0.005	0.07	<0.005	<0.005	<0.03	<0.060	< 0.01	<0.0005	<0.005	<0.005	11
WNGSEEP	8810	<0.005	0.12	0.005	<0.005	<0.03	<0.005	0.01	<0.0008	<0.005	<0.005	13
WNGSEEP	8820	<0.005	0.11	<0.010	0.020	<0.03	<0.005	0.01	<0.0004	<0.005	<0.010	15
WNSP008	8801	<0.005	0.09	<0.005	<0.005	0.02	0.024	2.25	<0.0005	<0.005	<0.005	45
WNSP008	8810	<0.005	0.11	0.004	<0.007	0.03	<0.005	2.35	<0.0005	<0.005	<0.005	66
WNSP008	8820	<0.005	0.08	<0.010	0.021	0.04	0.004	2.23	<0.0004	<0.005	<0.010	48
WNW80-05	8801	<0.005	0.06	<0.005	<0.005	0.09	<0.060	0.02	<0.0005	<0.005	<0.005	7
WNW80-05	8810	<0.005	0.08	0.007	<0.005	0.69	<0.005	0.14	<0.0008	<0.005	<0.005	15
WNW80-05	8820	<0.005	0.09	<0.010	<0.010	0.54	<0.005	0.04	<0.0004	<0.005	<0.010	11
WNW80-06	8801	<0.005	0.04	<0.005	<0.005	0.78	<0.060	9.08	<0.0005	<0.005	<0.005	12
WNW80-06	8810	<0.005	0.11	<0.007	<0.010	0.38	<0.005	11.00	<0.0002	<0.005	<0.010	18
WNW80-06	8820	<0.005	0.06	<0.010	0.011	0.37	<0.005	7.95	<0.0004	<0.005	<0.010	18
WNW86-03	8801	<0.005	0.23	<0.005	<0.005	<0.03	<0.060	< 0.01	<0.0005	<0.005	<0.005	22
WNW86-03	8810	<0.005	0.24	0.006	<0.007	0.02	<0.005	0.01	<0.0005	<0.005	<0.005	27
WNW86-03	8820	<0.005	0.20	<0.010	<0.010	0.05	<0.005	0.01	0.0019	<0.005	<0.010	29
WNW86-04	8801	<0.005	0.18	<0.005	<0.005	0.02	<0.060	0.04	<0.0005	<0.005	<0.005	22
WNW86-04	8810	<0.005	0.24	0.005	<0.007	0.04	<0.005	0.04	<0.0005	<0.005	<0.005	27
WNW86-04	8820	<0.005	0.24	<0.010	<0.010	0.08	<0.005	0.04	<0.0004	<0.005	<0.010	25
WNW86-05	8801	<0.200	0.11	<0.002	<0.020	4.10	<0.050	7.91	<0.0002	<0.200	<0.010	38
WNW86-05	8810	0.007	0.13	<0.002	<0.020	5.36	<0.050	11.08	<0.0002	<0.002	<0.010	70
WNW86-05	8820	0.003	0.09	<0.002	<0.020	2.31	<0.002	7.92	<0.0002	<0.002	<0.001	29

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-10
1988 RADIOACTIVITY CONCENTRATIONS FOR GROUNDWATER IN THE
LOW-LEVEL RADIOACTIVE WASTE LAGOON SYSTEM
GROUNDWATER MONITORING UNIT
(µCi/mL)

LOCATION CODE	PERIOD SAMPLED*	ALPHA	BETA	Tritium	Cs-137	Co-60
WNW86-06	8801	<1.95 E-09	7.68 E-09 ± 1.31 E-09	<1.00 E-07	<1.08 E-07	<1.09 E-07
WNW86-06	8810	<1.33 E-09	5.59 E-09 ± 1.15 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-06	8820	<3.44 E-09	9.37 E-09 ± 1.70 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNGSEEP	8801	<7.72 E-10	1.99 E-09 ± 9.12 E-10	1.31 E-06 ± 7.04 E-08	<1.08 E-07	<1.09 E-07
WNGSEEP	8810	1.01 E-08 ± 3.25 E-09	1.67 E-08 ± 1.54 E-09	1.69 E-06 ± 7.61 E-08	<3.05 E-08	<3.20 E-08
WNGSEEP	8820	<8.56 E-10	2.72 E-09 ± 9.29 E-10	1.18 E-06 ± 8.26 E-08	<3.05 E-08	<3.20 E-08
WNSP008	8901	1.99 E-09 ± 1.82 E-09	3.27 E-08 ± 1.95 E-09	7.27 E-06 ± 1.55 E-07	<1.08 E-07	<1.09 E-07
WNSP008	8810	<1.40 E-09	3.72 E-08 ± 2.04 E-09	7.45 E-06 ± 1.57 E-07	<3.05 E-08	<3.20 E-08
WNSP008	8820	<1.19 E-09	3.72 E-08 ± 2.06 E-09	7.19 E-06 ± 1.76 E-07	<3.05 E-08	<3.20 E-08
WNW80-05	8801	<1.05 E-09	1.20 E-09 ± 8.98 E-10	2.82 E-07 ± 6.15 E-08	<1.08 E-07	<1.09 E-07
WNW80-05	8810	<8.83 E-10	2.93 E-09 ± 9.97 E-10	7.44 E-07 ± 6.76 E-08	<3.05 E-08	<3.20 E-08
WNW80-05	8820	<1.08 E-09	2.52 E-09 ± 9.64 E-10	7.31 E-07 ± 7.76 E-08	<3.05 E-08	<3.20 E-08
WNW80-06	8801	<1.26 E-09	2.75 E-09 ± 1.01 E-09	7.97 E-07 ± 9.15 E-08	<1.08 E-07	<1.09 E-07
WNW80-06	8810	<1.41 E-09	5.08 E-09 ± 1.13 E-09	7.22 E-07 ± 7.61 E-08	<3.05 E-08	<3.20 E-08
WNW80-06	8820	<1.03 E-09	2.47 E-09 ± 9.74 E-10	8.76 E-07 ± 9.63 E-08	<3.05 E-08	<3.20 E-08
WNW86-03	8801	<1.38 E-09	7.43 E-09 ± 1.23 E-09	1.13 E-06 ± 6.86 E-08	<1.08 E-07	<1.09 E-07
WNW86-03	8810	<7.35 E-10	8.93 E-09 ± 1.23 E-09	1.39 E-06 ± 7.10 E-08	<3.05 E-08	<3.20 E-08
WNW86-03	8820	<1.31 E-09	9.36 E-09 ± 1.27 E-09	1.20 E-06 ± 8.24 E-08	<3.05 E-08	<3.20 E-08
WNW86-04	8801	<1.59 E-09	2.50 E-08 ± 1.75 E-09	1.47 E-06 ± 7.23 E-08	<1.08 E-07	<1.09 E-07
WNW86-04	8810	<8.76 E-10	3.07 E-08 ± 1.85 E-09	1.44 E-06 ± 7.19 E-08	<3.05 E-08	<3.20 E-08
WNW86-04	8820	<1.25 E-09	3.64 E-08 ± 2.03 E-09	1.37 E-06 ± 8.43 E-08	<3.05 E-08	<3.20 E-08
WNW86-05	8801	6.12 E-08 ± 6.47 E-09	1.80 E-05 ± 3.96 E-08	1.86 E-05 ± 3.12 E-07	<1.08 E-07	<1.09 E-07
WNW86-05	8810	8.12 E-09 ± 2.70 E-09	2.84 E-05 ± 5.10 E-08	1.73 E-05 ± 2.96 E-07	<3.05 E-08	<3.20 E-08
WNW86-05	8820	2.59 E-08 ± 4.06 E-09	2.11 E-05 ± 4.27 E-08	1.24 E-05 ± 2.24 E-07	<3.05 E-08	<3.20 E-08

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-11
1988 WATER QUALITY PARAMETERS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT

LOCATION CODE	PERIOD SAMPLED*	pH	CONDUCTIVITY (@25 °C) (µmhos/cm)	mg/L TOC	PHENOL	TOX	CHLORIDE	NITRATE-N	SULFATE	FLUORIDE
WNW83-1D	8801	7.85	297	1.8	<0.01	N/A	6.1	0.10	1	0.46
WNW83-1D	8810	7.85	296	5.9	<0.01	<0.005	6.8	0.14	9	0.51
WNW83-1D	8820	8.01	293	3.9	<0.01	<0.010	6.5	0.27	8	0.44
WNW86-10	8801	8.33	593	0.7	<0.01	N/A	1.5	0.03	54	0.13
WNW86-10	8810	8.30	593	<1.0	<0.01	<0.005	1.4	0.06	94	0.12
WNW86-10	8820	7.94	626	14.6	<0.01	<0.010	<1.0	0.06	67	0.15
WNW86-11	8801	7.88	654	1.3	<0.01	N/A	0.9	0.14	96	0.18
WNW86-11	8810	7.95	664	2.9	<0.01	<0.005	1.0	0.24	123	0.22
WNW86-11	8820	7.76	698	9.9	<0.02	<0.010	<1.0	0.16	120	0.16

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-12
1988 TOTAL METALS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW83-1D	8801	<0.005	0.68	<0.005	0.004	2.98	<0.050	0.11	<0.0002	<0.005	<0.005	27
WNW83-1D	8810	0.005	0.76	<0.005	<0.010	5.78	<0.005	0.13	<0.0002	<0.005	<0.010	24
WNW83-1D	8820	<0.005	0.72	<0.010	0.013	6.80	0.009	0.15	<0.0004	<0.005	0.015	22
WNW86-10	8801	<0.005	0.19	<0.005	0.005	1.15	<0.030	0.07	0.0047	<0.005	<0.005	61
WNW86-10	8810	0.025	0.20	0.008	0.014	3.15	0.005	0.14	<0.0005	<0.005	<0.005	63
WNW86-10	8820	0.011	0.23	<0.010	0.072	16.83	0.040	0.65	<0.0004	<0.005	0.009	64
WNW86-11	8801	<0.005	0.12	<0.005	0.038	5.93	0.029	0.27	0.0047	<0.005	<0.005	56
WNW86-11	8810	0.006	0.09	<0.007	0.054	11.98	0.006	0.28	<0.0002	<0.005	<0.010	59
WNW86-07	8820	<0.005	0.11	<0.10	0.064	9.10	0.043	0.32	<0.0004	<0.005	<0.010	63

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-13
1988 DISSOLVED METALS FOR
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT
(mg/L)

LOCATION CODE	PERIOD SAMPLED*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	SODIUM
WNW83-1D	8801	<0.005	0.76	<0.005	<0.005	<0.03	<0.050	0.10	<0.0002	<0.005	<0.005	27
WNW83-1D	8810	0.005	0.78	<0.007	<0.010	0.02	<0.005	0.09	<0.0002	<0.005	<0.010	25
WNW83-1D	8820	<0.005	0.75	<0.010	0.010	0.08	<0.005	0.12	<0.0004	<0.005	0.010	26
WNW86-10	8801	0.006	0.19	<0.005	<0.005	0.06	<0.030	0.05	<0.0002	<0.005	<0.005	62
WNW86-10	8810	0.007	0.17	<0.005	<0.005	0.16	<0.005	0.06	<0.0005	<0.005	<0.005	61
WNW86-10	8820	<0.005	0.15	0.009	0.013	0.03	<0.005	0.09	<0.0004	<0.005	<0.010	67
WNW86-11	8801	<0.005	0.08	<0.005	<0.005	<0.02	<0.030	0.11	<0.0002	<0.005	<0.005	57
WNW86-11	8810	<0.005	0.08	<0.007	0.010	0.02	<0.005	0.09	<0.0002	<0.005	<0.010	59
WNW86-11	8820	<0.005	0.06	<0.10	0.021	<0.03	<0.005	0.08	<0.0004	<0.005	<0.010	69

Notes: Each entry represents the average of four replicate measurements per period. Cohen's method from the "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document" was used to average the mixture of positive and less-than-detection-limit values.

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

TABLE E-14
1988 RADIOACTIVITY CONCENTRATIONS FOR GROUNDWATER IN THE
NRC-LICENSED DISPOSAL AREA
GROUNDWATER MONITORING UNIT
(μCi/mL)

LOCATION CODE	PERIOD SAMPLED*	ALPHA	BETA	Tritium	Cs-137	Co-60
WNW83-1D	8801	<8.52 E-10	2.62 E-09 ± 9.17 E-10	<1.00 E-07	<1.08 E-07	<1.09 E-07
WNW83-1D	8810	2.36 E-09 ± 9.83 E-10	4.8E E-09 ± 9.92 E-10	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW83-1D	8820	1.18 E-09 ± 9.64 E-10	3.32 E-09 ± 9.17 E-10	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-10	8801	3.47 E-09 ± 1.78 E-09	6.70 E-09 ± 1.15 E-09	1.18 E-07 ± 5.24 E-08	<1.08 E-07	<1.09 E-07
WNW86-10	8810	1.27 E-08 ± 4.85 E-09	3.02 E-08 ± 2.15 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-10	8820	<1.71 E-09	8.09 E-09 ± 1.25 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-11	8901	8.13 E-09 ± 3.33 E-09	1.43 E-08 ± 1.52 E-09	<1.00 E-07	<1.08 E-07	<1.09 E-07
WNW86-11	8810	3.27 E-09 ± 1.81 E-09	7.82 E-09 ± 1.22 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08
WNW86-11	8820	<1.52 E-09	5.72 E-09 ± 1.13 E-09	<1.00 E-07	<3.05 E-08	<3.20 E-08

* Periods: 8801, 1st Quarter; 8810, 1st Semiannual; 8820, 2nd Semiannual.

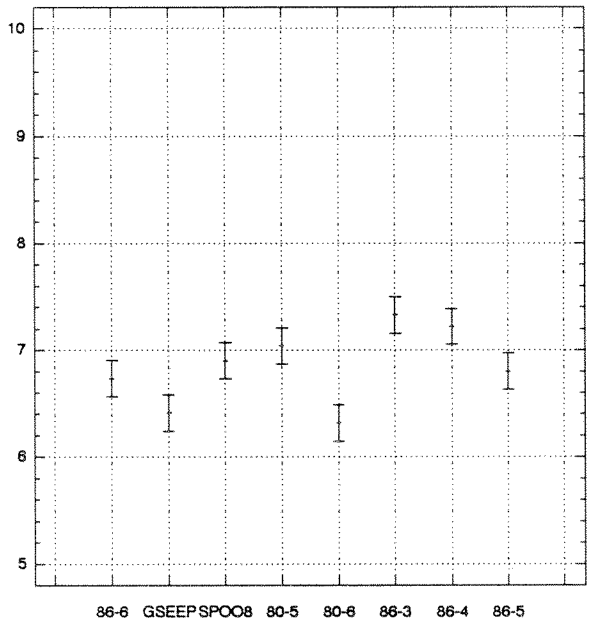

Figure E-1
pH in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

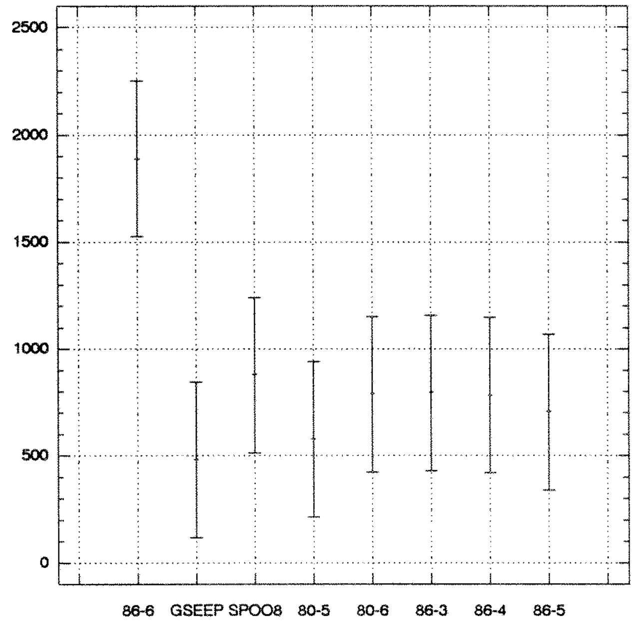

Figure E-2
Conductivity (μmhos/cm at 25 °C) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

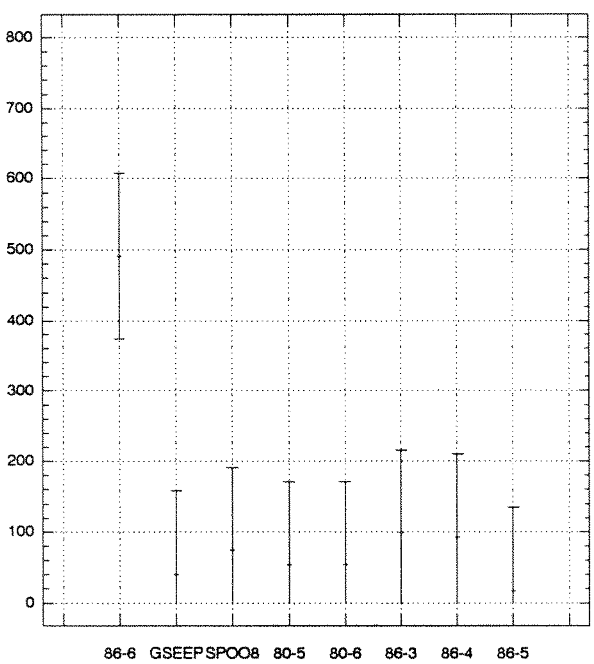

Figure E-3
Chloride (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

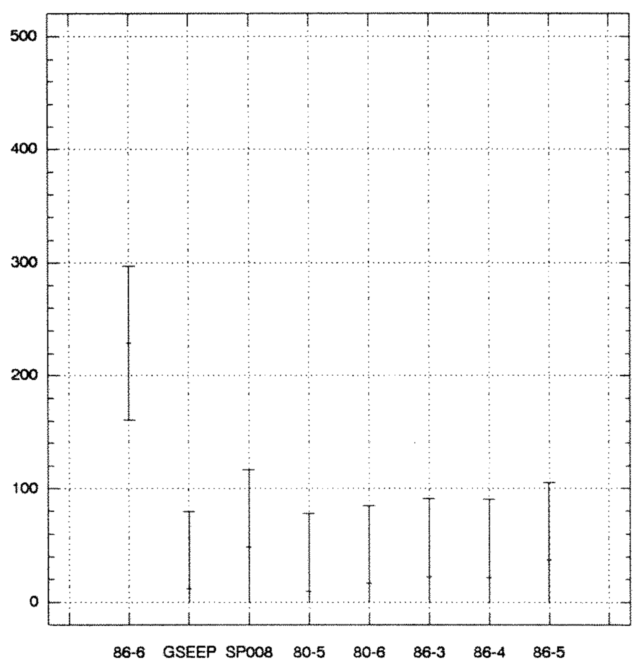

Figure E-4
Dissolved sodium (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

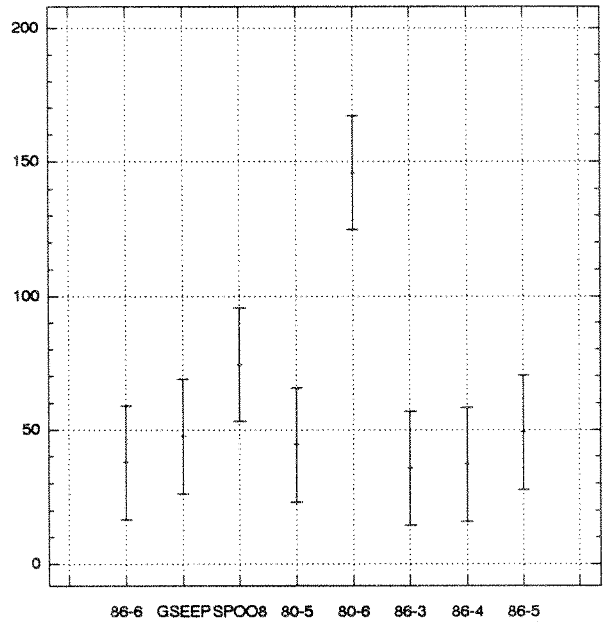

Figure E-5
Sulfate (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

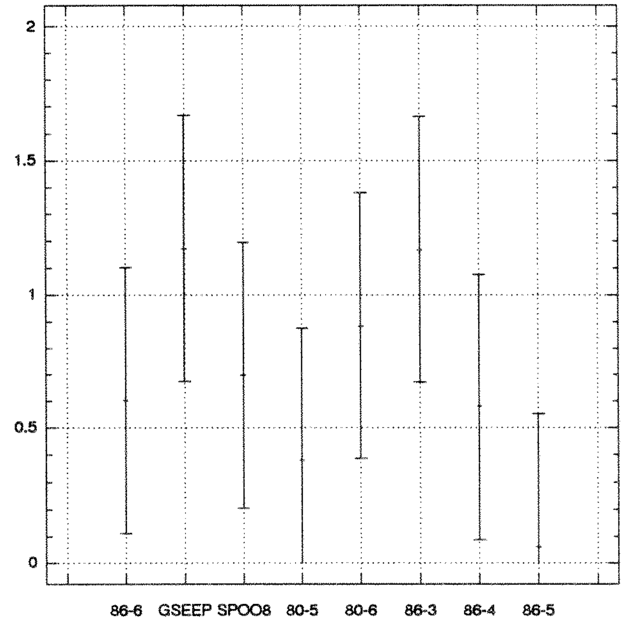

Figure E-6
Nitrate-N (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

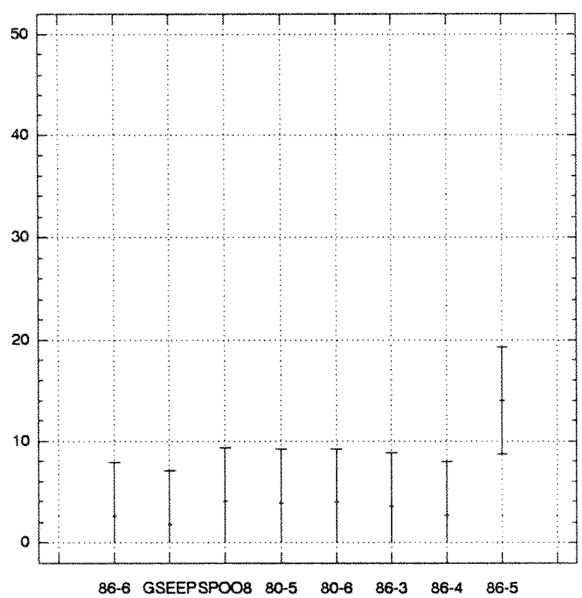

Figure E-7
Total organic carbon (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

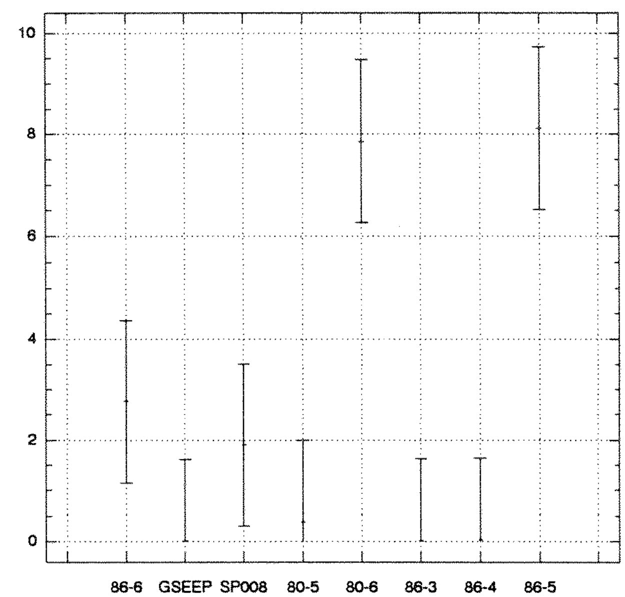

Figure E-8
Dissolved manganese (mg/L) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

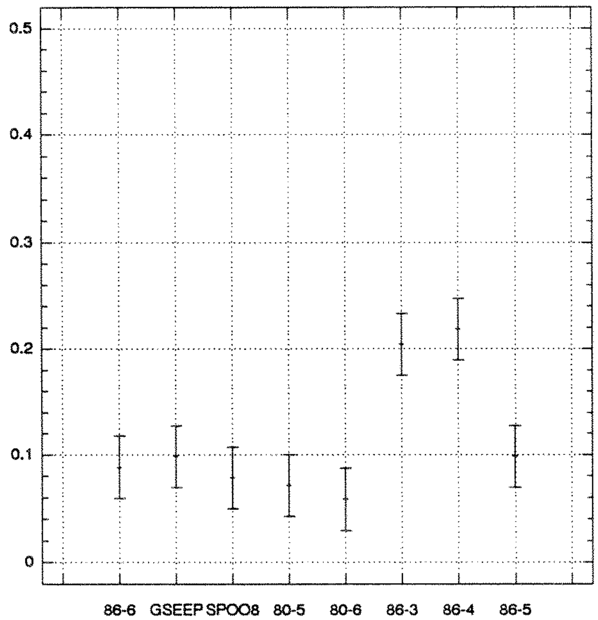

Figure E-9
Dissolved barium (mg/L) in groundwater samples from the Low-level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

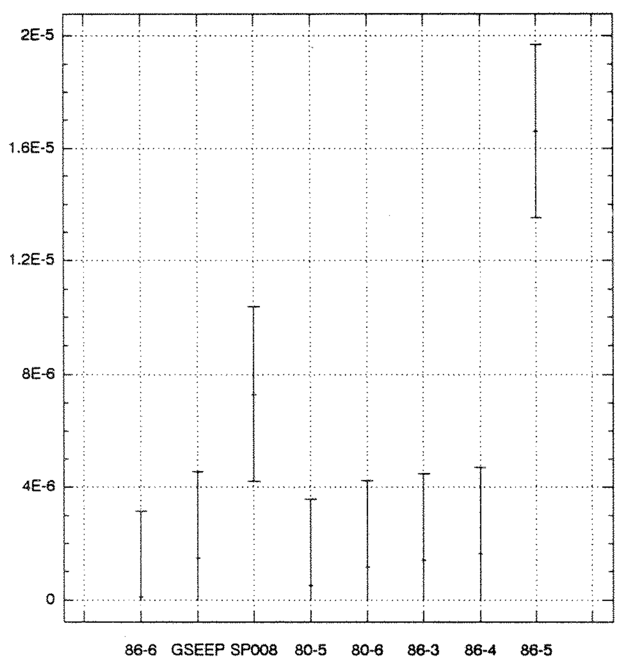

Figure E-10
Tritium activity (μCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient. Figure E-11 follows without Well 86-5 to provide adequate scaling.

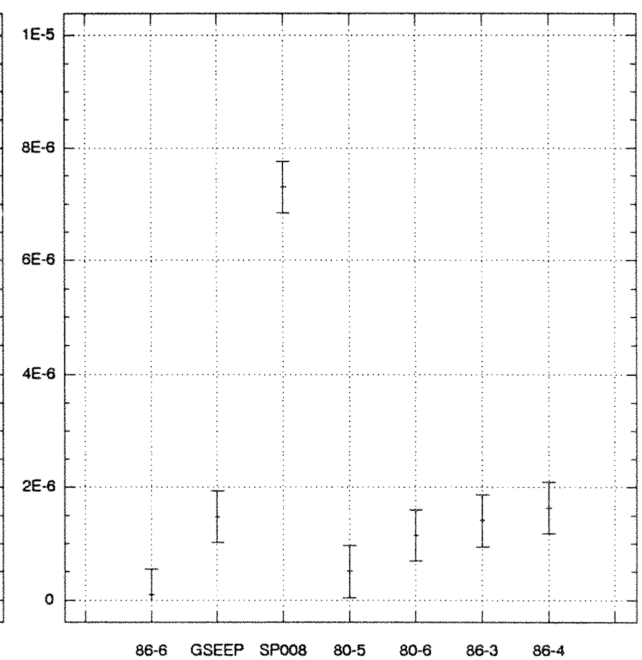

Figure E-11
Tritium activity (μCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit , without Well 86-5.

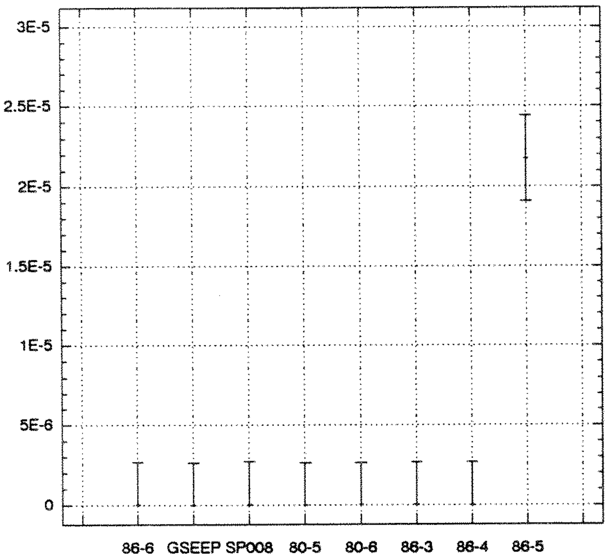

Figure E-12
Gross Beta activity (µCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit. Well 86-6 is upgradient. Figure E-13 follows without Well 86-5 to provide adequate scaling.

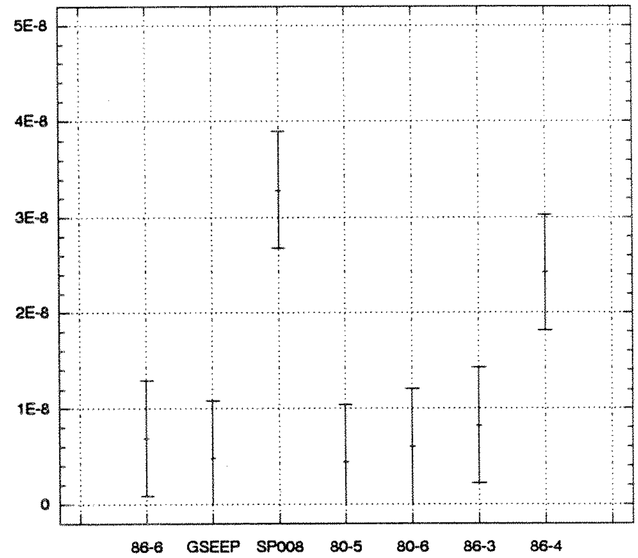

Figure E-13
Gross Beta activity (µCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon Monitoring Unit, without Well 86-5.

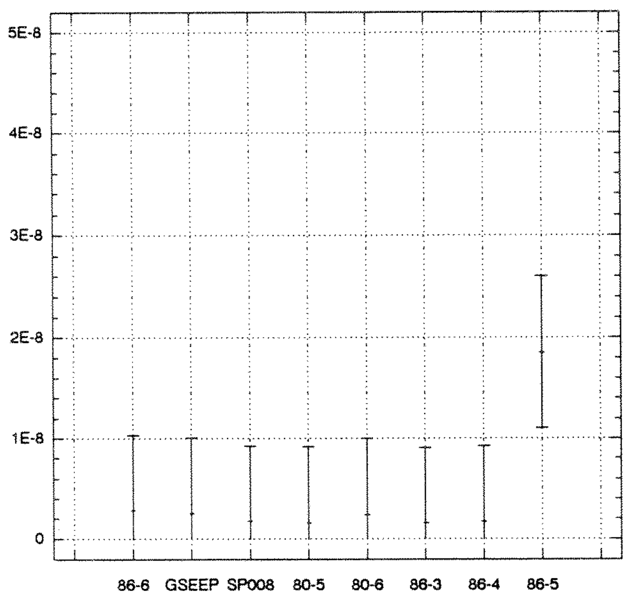

Figure E-14
Gross Alpha activity (µCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

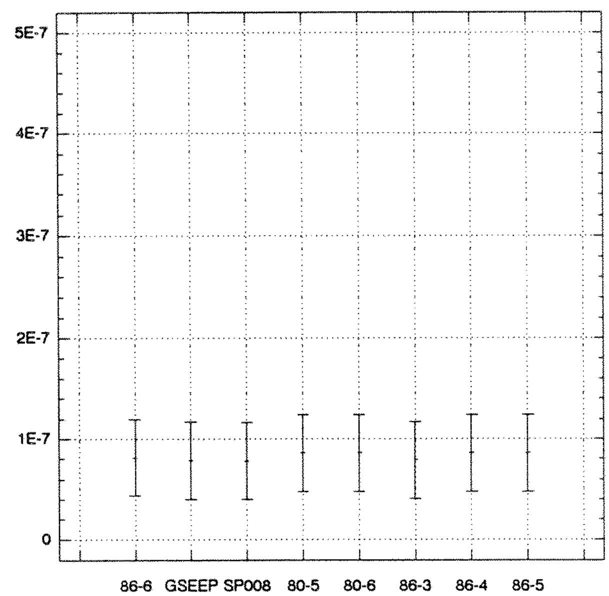

Figure E-15
Cesium activity (µCi/mL) in groundwater samples from the Low-Level Radioactive Waste Lagoon System Monitoring Unit. Well 86-6 is upgradient.

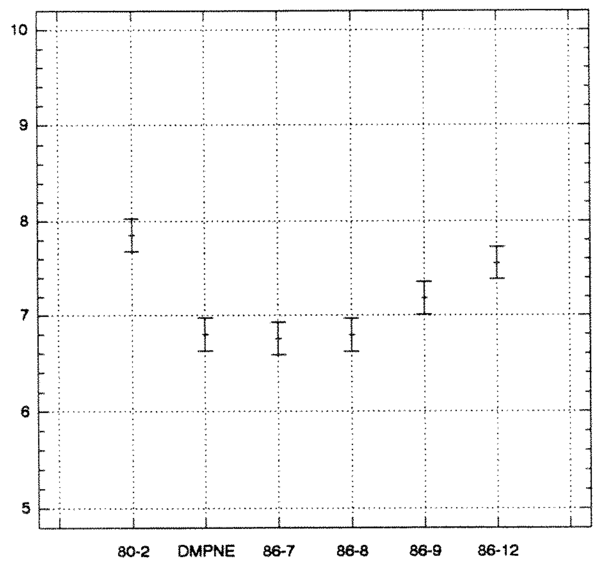

Figure E-16
pH in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

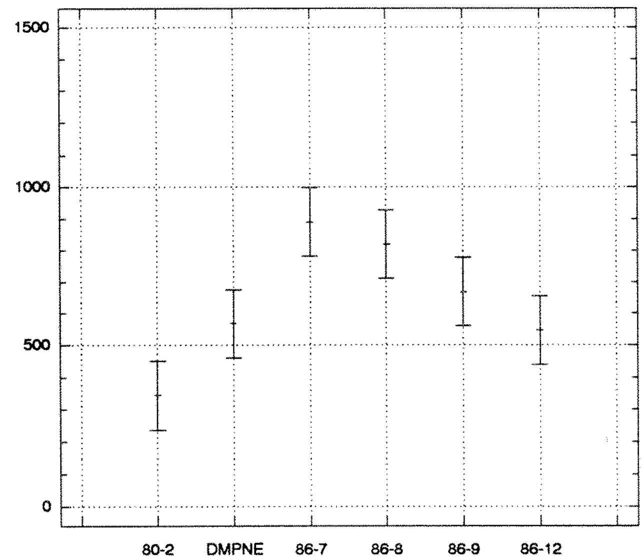

Figure E-17
Conductivity (μmhos/cm at 25 °C) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

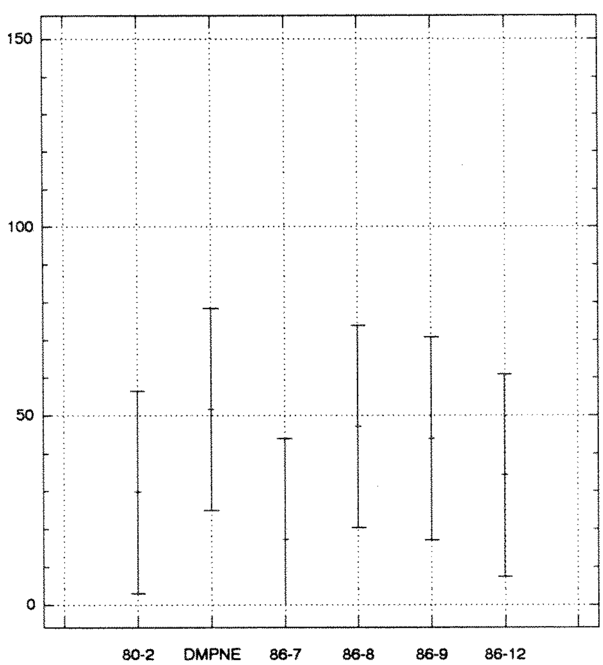

Figure E-18
Chloride (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

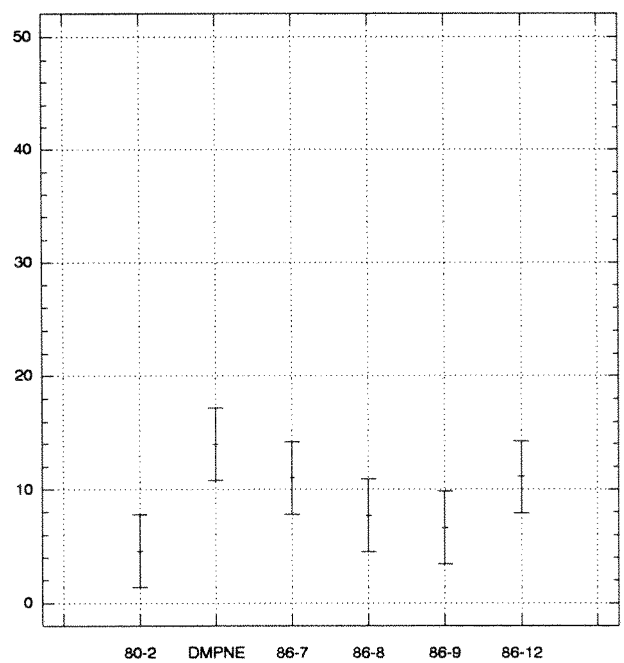

Figure E-19
Dissolved sodium (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

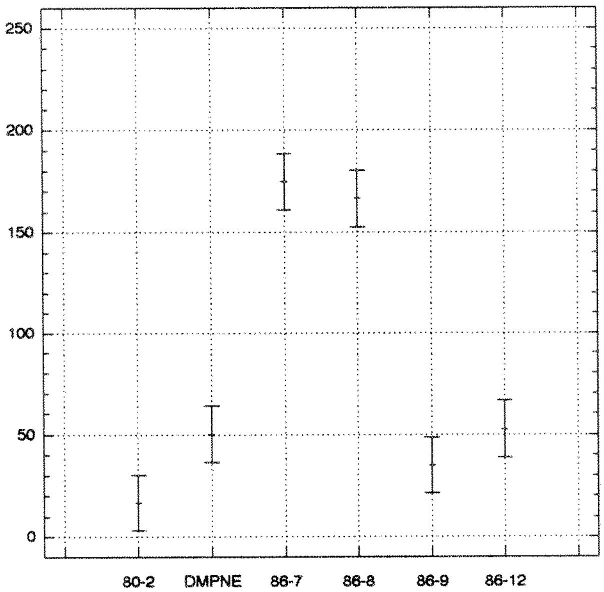

Figure E-20
Sulfate (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

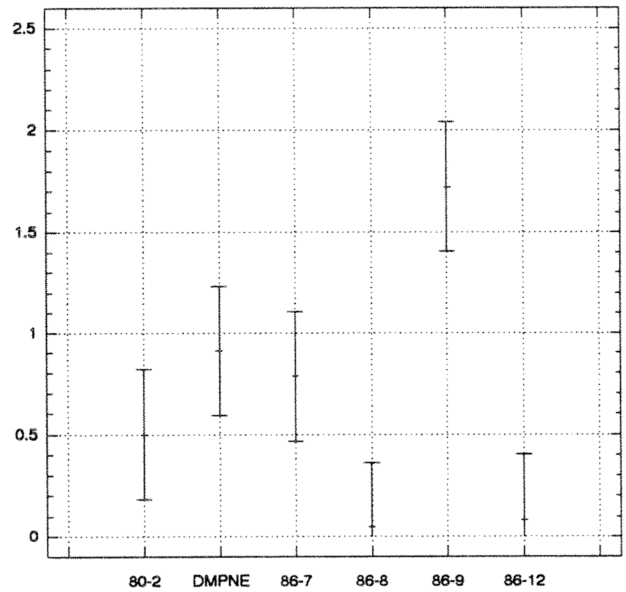

Figure E-21
Nitrate-N (mg/L) in groundwater samples from the High-Level Radioactive Waste tank Complex Monitoring Unit. Well 80-2 is upgradient.

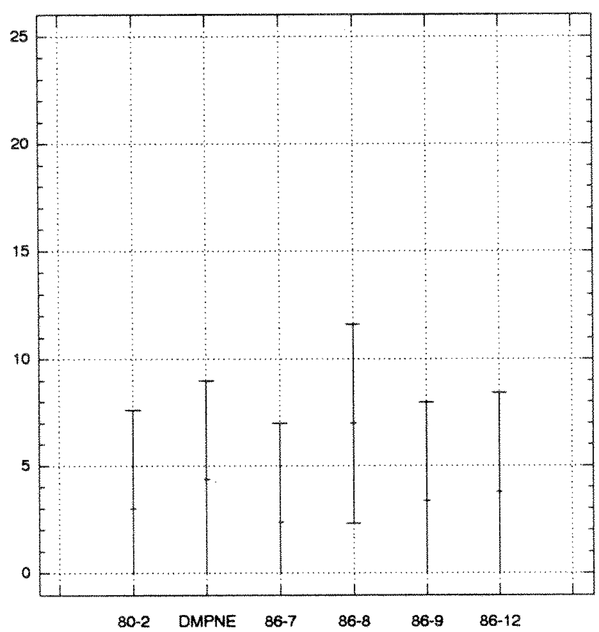

Figure E-22
Total organic carbon (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

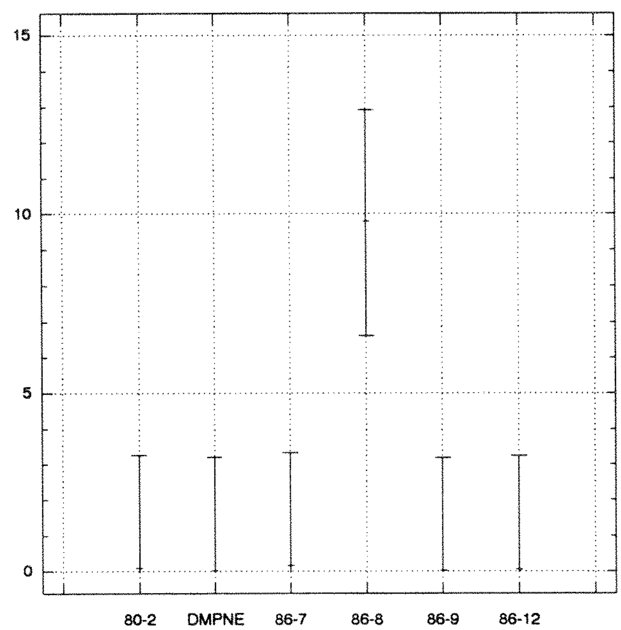

Figure E-23
Dissolved manganese (mg/L) in groundwater samples from the High-Level Radioactive waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

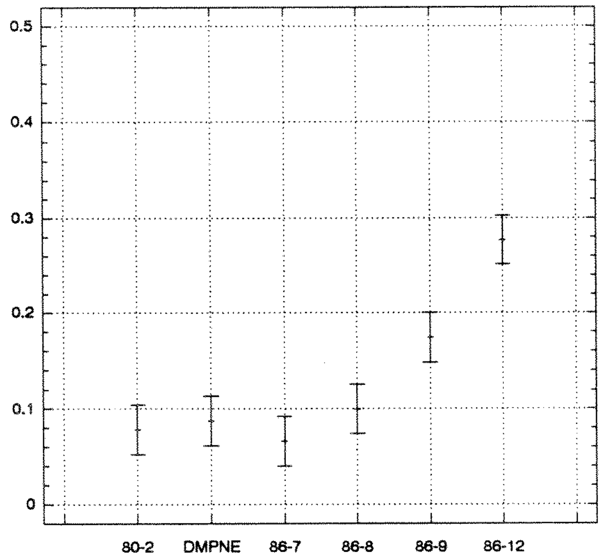

Figure E-24
Dissolved barium (mg/L) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

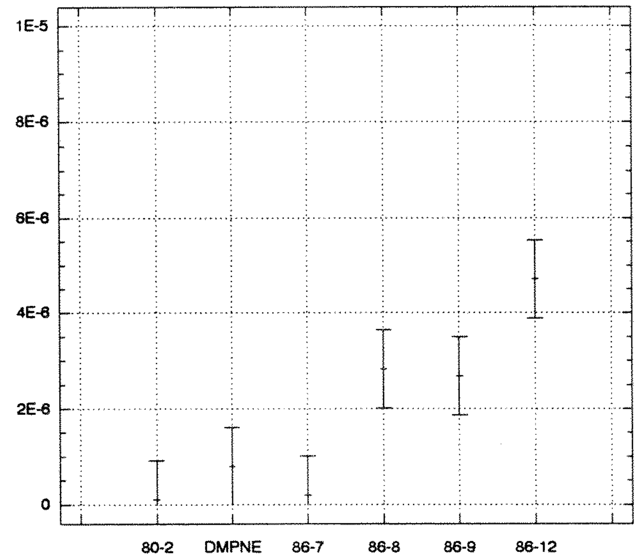

Figure E-25
Tritium activity (μCi/mL) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

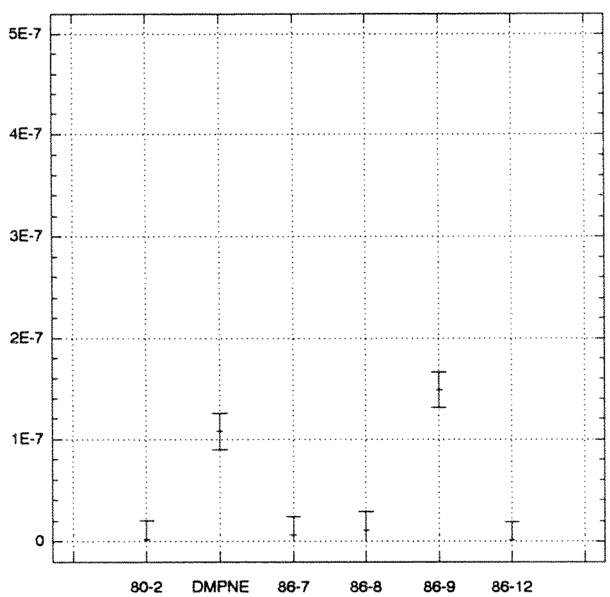

Figure E-26
Gross beta activity (μCi/mL) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

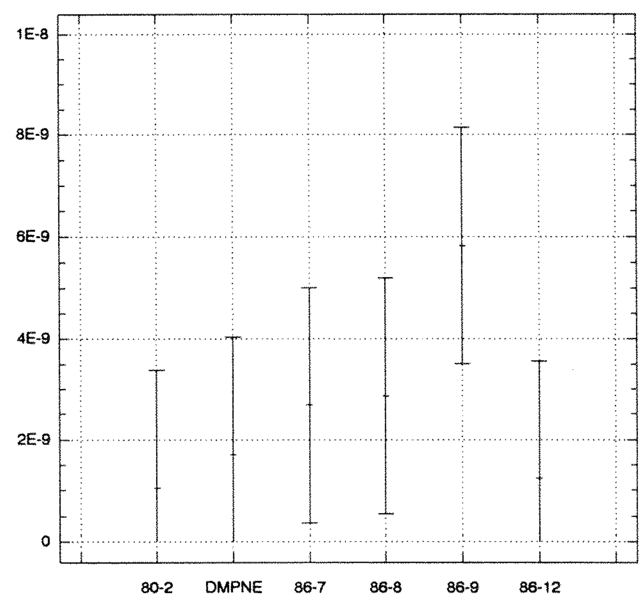

Figure E-27
Gross alpha activity (μCi/mL) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

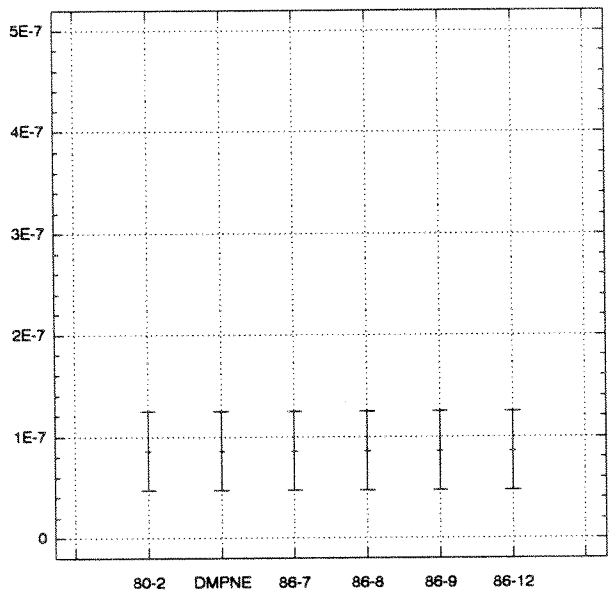

Figure E-28
Cesium activity (μCi/mL) in groundwater samples from the High-Level Radioactive Waste Tank Complex Monitoring Unit. Well 80-2 is upgradient.

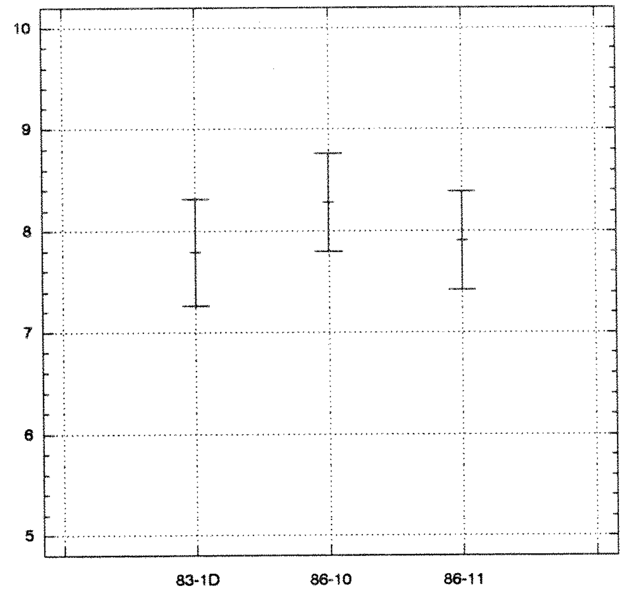

Figure E-29
pH in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

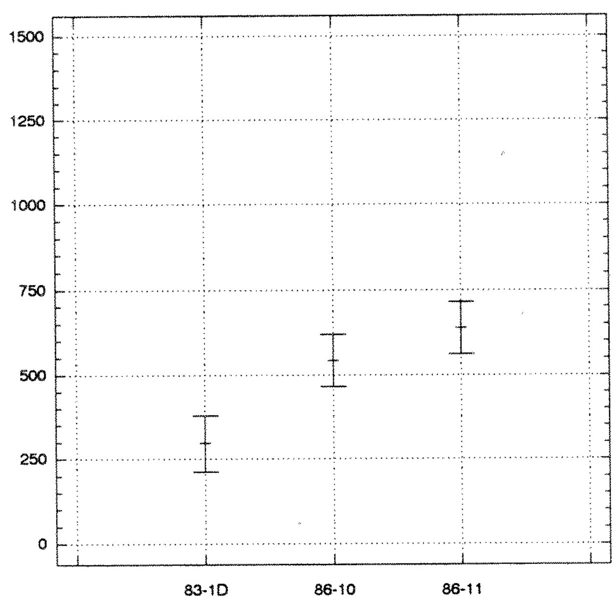

Figure E-30
Conductivity (μmhos/cm at 25 °C) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

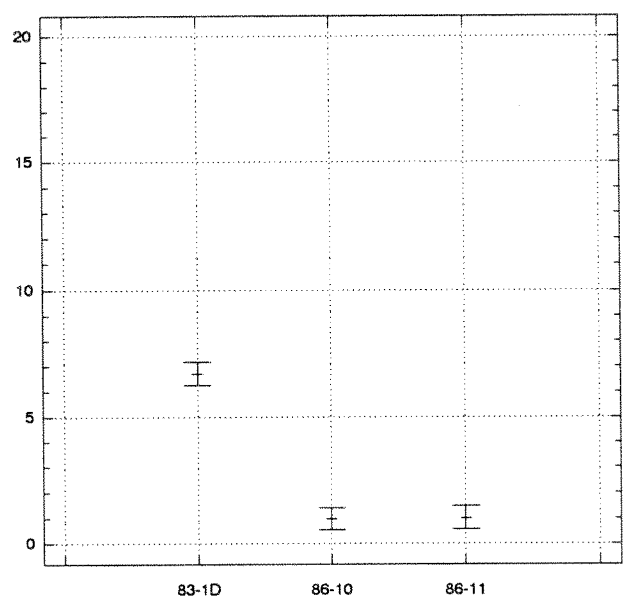

Figure E-31
Chloride (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

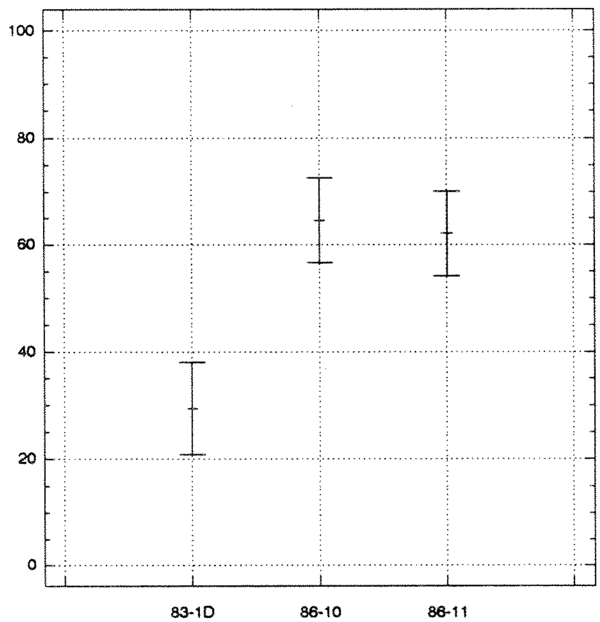

Figure E-32
Dissolved sodium (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

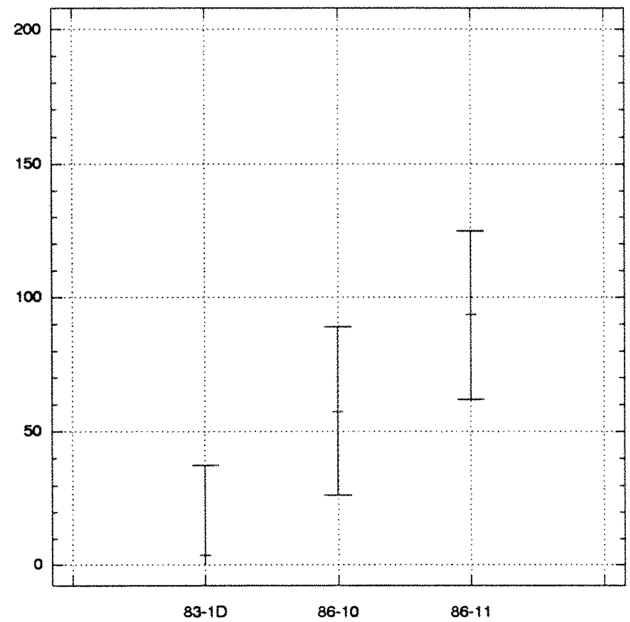

Figure E-33
Sulfate (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

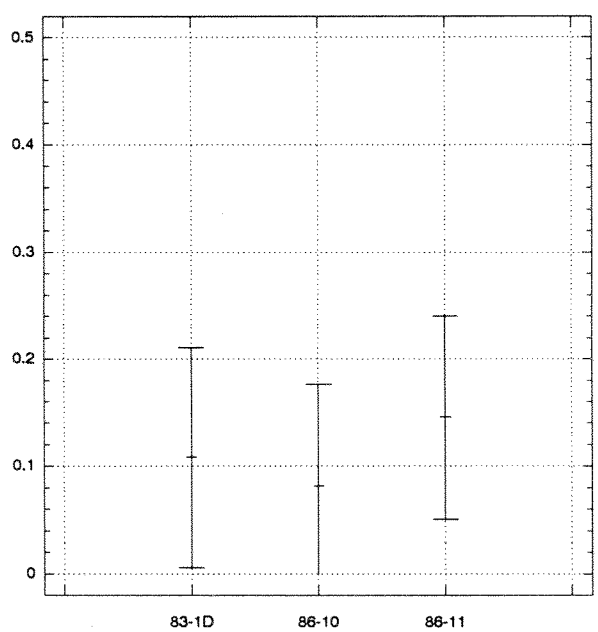

Figure E-34
Nitrate-N (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

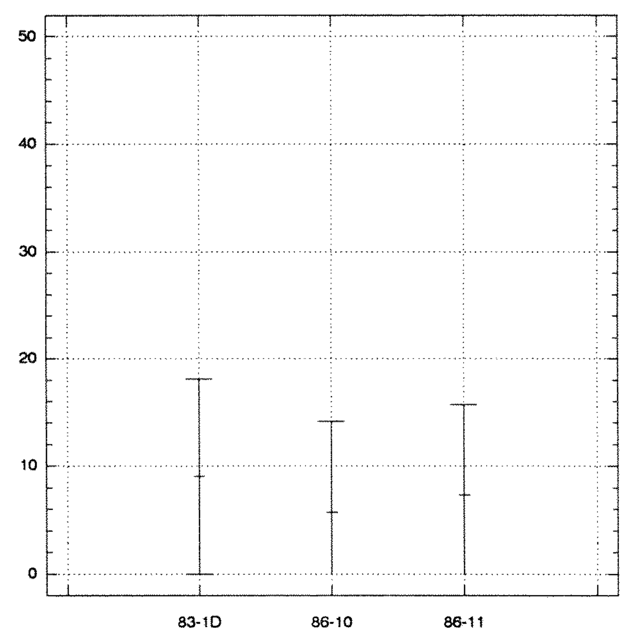

Figure E-35
Total organic carbon (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

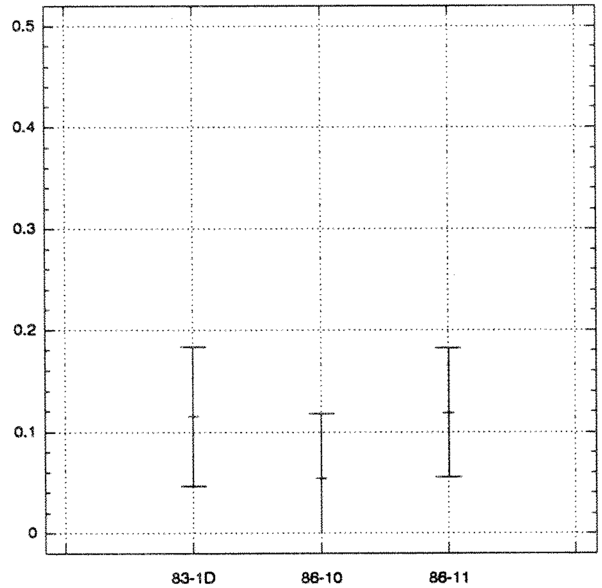

Figure E-36
Dissolved manganese (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

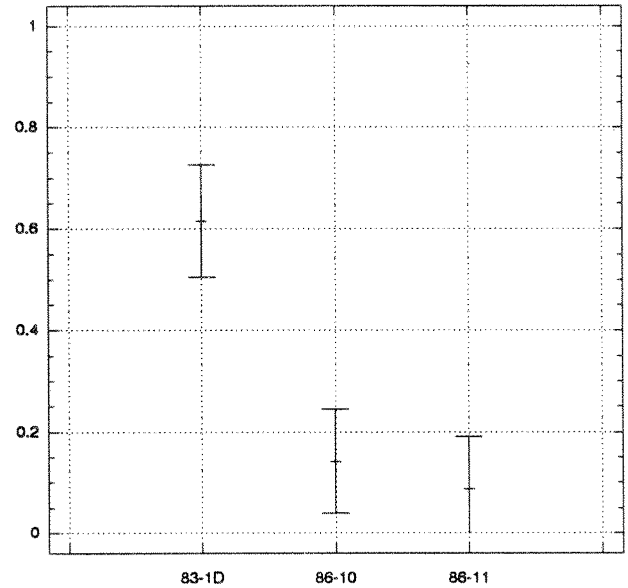

Figure E-37
Dissolved barium (mg/L) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

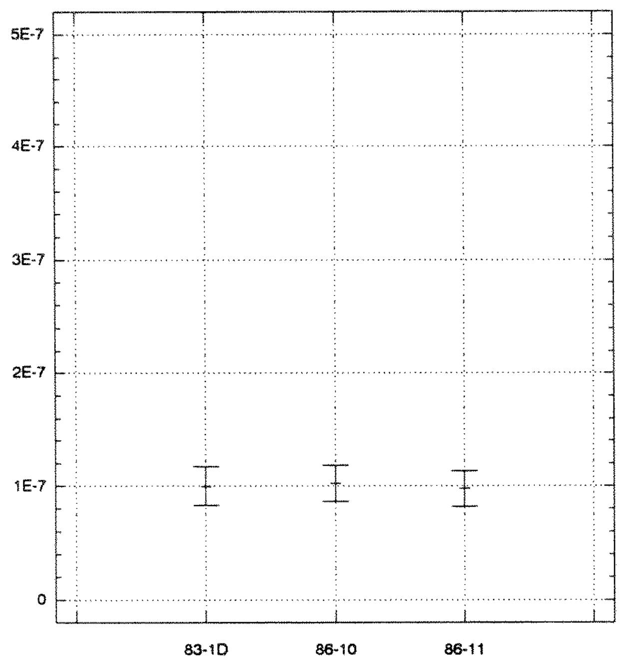

Figure E-38
Tritium activity (μCi/mL) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

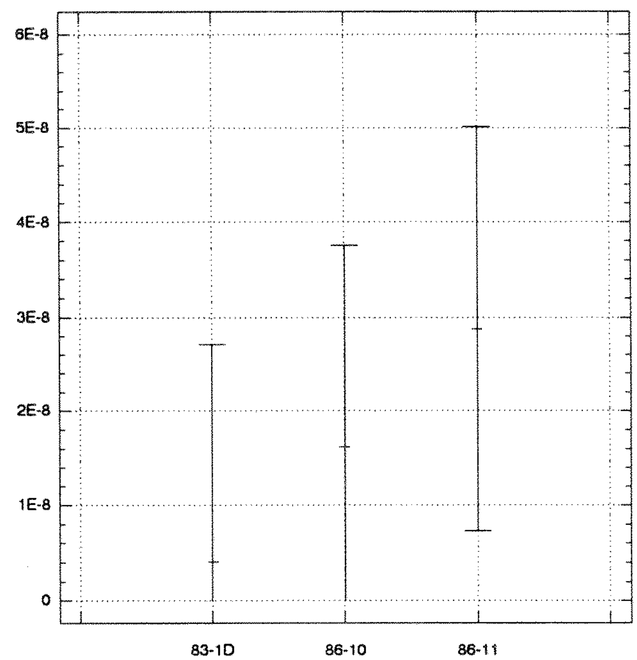

Figure E-39
Gross beta activity (μCi/mL) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

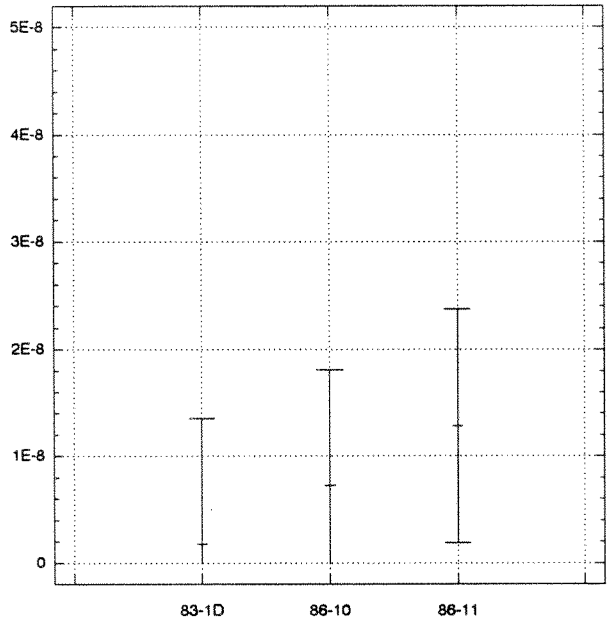

Figure E-40
Gross alpha activity (μCi/mL) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

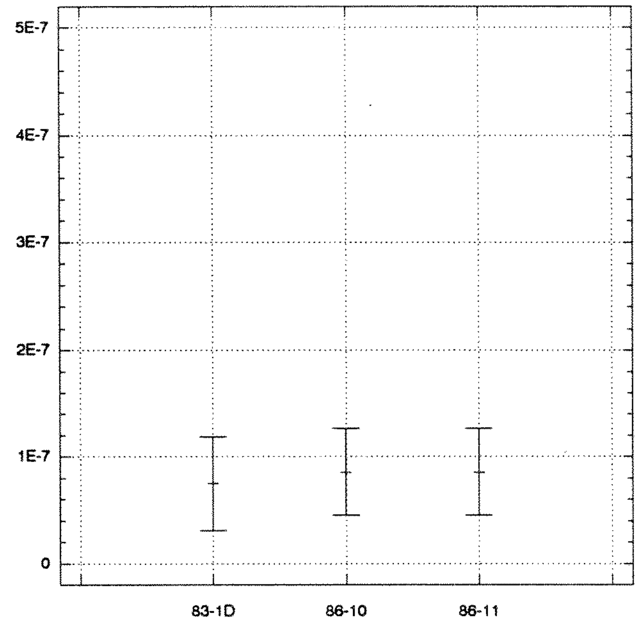

Figure E-41
Cesium activity (μCi/mL) in groundwater samples from the NRC-Licensed Disposal Area Monitoring Unit. Well 83-1D is upgradient.

APPENDIX F
GLOSSARY, ACRONYMS, AND UNITS

GLOSSARY, ACRONYMS, AND CONVERSION TABLES

Aquifer - A permeable geologic unit that can transmit significant quantities of water.

Background Radiation - The radioactivity in the environment, including cosmic rays from space and radiation that exists elsewhere - in the air, in the earth, and in manmade materials that surround us. In the United States, the average person receives 300 millirem of background radiation per year.

Becquerel (Bq) - A unit of activity equal to one nuclear transformation per second ($1 Bq = 1 s^{-1}$) The former special-named unit of activity, the curie, is equal to 3.7×10^{10} Bq.

Confined Aquifer - An aquifer that is bounded above and below by less permeable layers. Ground water in the confined aquifer is under a pressure greater than the atmospheric pressure.

Cosmic Radiation - High-energy subatomic particles from outer space, which bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

Counting Error - The variability caused by the inherent random nature of radioactive disintegration and the detection process.

Curie (Ci) - A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

Detection Level - The minimum concentration of a substance that can be measured with a 99 percent confidence that the analytical concentration is greater than zero.

Derived Concentration Guide (DCG) - Concentrations of radionuclides in air and water that under conditions of continuous exposure (365 d/yr) a person inhaling 8400 m^3 of air or ingesting 730 L of water per year would receive an annual effective dose equivalent rate of 100 mrem/yr from either mode of exposure. Committed dose equivalent is included for radionuclides with long, effective half lives.

Dispersion - The process whereby solutes are spread or mixed as they are transported by ground water as it moves through sediments.

Dosimeter - A portable device for measuring the total accumulate exposure to ionizing radiation.

Effective Dose - See "Effective Dose Equivalent" under "Radiation Dose."

Effluent - The liquid or gaseous waste streams released to the environment from a facility.

Effuent Monitoring - Sampling or measuring specific liquid or gaseous effuent streams for the presence of polluntants.

Exposure - Subjecting a target (usually living tissue) to radiation.

Fallout - Radioactive materials mixed into the earth's atmosphere following a nuclear explosion. Fallout constantly precipitates onto the earth.

Groundwater - Subsurface water that is in the pore spaces of soil and geologic units.

Half-life - The length of time in which any radioactive substance will lose one-half of its radioactivity. The half-life may vary in length from a fraction of a second to thousands of years.

Ion Exchange - The reversible exchange of ions contained in a crystal for different ions in solution without destroying the crystal structure or disturbing the electrical neutrality.

Isotope - Different forms of the same chemical element that are distinguished by having different numbers of neutrons in the nucleus. A single element may have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

Long-Lived Isotope - A radionuclide that decays at such a slow rate that a quantity of it will exist for an extended period (half-life is greater than 3 years).

Short-Lived Isotope - A radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (half-life of 2 days or less).

Lacustrine Sediments - A sedimentary deposit consisting of material pertaining to, produced by, or formed in a lake or lakes.

Maximally Exposed Individual - A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

Mean - The average value of a series of measurements.

Median - The middle value in a set of results when the data are ranked in increasing or decreasing order.

Millirem (mrem) - A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 500 millirems (mrem) per year according to DOE standards. This limit does not include radiation received for medical treatment or the 100 to 250 mrem that people receive annually from background radiation.

Minimum Detectable Concentration - The smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

Offsite Locations - Sampling and measurement locations outside the West Valley Demonstration Project boundaries.

Onsite Locations - Sampling and measurement locations within the West Valley Demonstration Project boundaries.

Outfall - The end of a drain or pipe that carries waste water or other effluents into a ditch, pond, or river.

Person-rem - See "Collective Dose Equivalent" under "Radiation Dose."

Plume - The distribution of a pollutant in air or water after being released from a source.

Radiation - Refers to the process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

Alpha Radiation - The least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or outer dead layer of skin.

Beta Radiation - Emitted from a nucleus during fission. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

Gamma Radiation - A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding, such as concrete or steel, to be stopped.

Internal Radiation - Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or manmade radionuclides in body tissues.

Radiation Dose - For the purpose of this report, radiation doses are defined as follows:

Absorbed Dose - The amount of energy deposited by radiation in a given amount of material. Absorbed dose is measured in units of "rads" (see "Dose Equivalent").

Collective Dose Equivalent - The sum of the dose equivalents for individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population size.

Committed Dose Equivalent - The total dose equivalent accumulated in an organ or tissue in the 50 years following a single intake of radioactive materials into the body.

Cumulative Dose Equivalent - The total dose one could receive in a period of 50 years following release of the radionuclides to the environment, including the dose that could occur as a result of residual radionuclides remaining in the environment beyond the year of release.

Dose Equivalent - The product of the absorbed dose, the quality factor, and any other modifying factors. The dose equivalent is a quantity for comparing the biological effectiveness of different kinds of radiation on a common scale. The unit of dose equivalent is the rem. A millirem is one one-thousandth of a rem.

Effective Dose Equivalent - An estimate of the total risk of potential health effects from radiation exposure. It is the sum of the committed effective dose equivalent from internal deposition and the effective dose equivalent from external penetrating radiation received during a calendar year. The committee effective dose equivalent is the sum of the individual organ committed dose equivalents (50 year) multiplied by weighting factors that represent the proportion of the total random risk that each organ would receive from uniform irradiation of the whole body.

Radioactivity - A property possessed by some elements, such as uranium, whereby alpha, beta, or gamma rays are spontaneously emitted.

Radioisotope - A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen.

Radionuclide - A radioactive nuclide. There are several hundred known nuclides, both manmade and naturally occurring; nuclides are characterized by the number of neutrons and protons in an atom's nucleus.

Rem - An acronym for Roentgen Equivalent Man; a unit of radiation exposure that indicates the potential impact on human cells.

Sievert - A unit of dose equivalent from the International System of Units (SI) equal to 1 joule per kilogram.

Spent Fuel - Nuclear fuel that has been exposed in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

Standard Deviation - An indication of the dispersion of a set of results around their average.

Standard Error of the Mean - An indication of the dispersion of an estimated mean from the average of other estimates of the same mean.

Thermoluminescent Dosimeter (TLD) - A material that, after being exposed to radiation, luminesces upon being heated. The amount of light emitted is proportional to the amount of radiation (dose) to which it has been exposed.

Unconfined Aquifer - Contains groundwater that is not confined above by relatively impermeable rocks. The pressure at the top of the unconfined aquifer is equal to that of the atmosphere.

Water Table - A theoretical surface which is represented by the elevation of water surfaces in wells penetrating only a short distance into the unconfined aquifer.

Whole-Body Dose - A radiation dose that involves exposure of the entire body.

X/Q - A dispersion factor calculated using an atmospheric dispersion model from average annual meteorological data. It is used to estimate the air concentration from the total airborne release of a radionuclide. The resulting estimates of average annual air concentrations at specific locations away from the source can be used to calculate potential doses.

ACRONYMS

ANOVA – One-way Variance of Analysis

ALARA – As Low As Reasonably Achievable

BEIR – Committee on Biological Effects of Ionizing Radiations

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CSS – Cement Solidification System

D&D – Decontamination and Decommissioning

DCG – Derived Concentration Guide

DE – Dose Equivalent

DOE – Department of Energy

DOE-HQ – Department of Energy, Headquarters Office

DOE-ID – Department of Energy, Idaho Project Office

EA – Environmental Assessment

EE – Environmental Evaluation

EIS – Environmental Impact Statement

ELAP – Environmental Laboratory Accreditation Program

EML – Environmental Measurements Laboratory

EMSL – Environmental Monitoring Systems Laboratory (Las Vegas)

EPA – Environmental Protection Agency

FONSI – Finding of No Signicant Impact

FY – Fiscal Year

HLW – High-Level Radioactive Waste

ICRP – Internation Commission on Radiological Protection

INEL – Idaho National Engineering Laboratory

IRTS – Integrated Radwaste Treatment System

LLD – Lower limit of detection

LLW – Low-Level Radioactive Waste

LLWTF – Low-Level Waste Treatment Facility

LWTS – Liquid Waste Treatment System

MDC – Minimum Detectable Concentration

NBS – National Bureau of Standards

NCRP – National Council on Radiation Protection and Measurements

NDA – Nuclear Regulatory Commission Licensed Disposal Area

NEPA – National Environmental Policy Act

NESHAP – National Emission Standards for Hazardous Pollutants

NFS – Nuclear Fuel Services Company

NOI – Notice of Intent

NRC – Nuclear Regulatory Commission

NWPA – Nuclear Waste Policy Act

NYSDEC – New York State Department of Environmental Conservation

NYSDOH – New York State Department of Health

NYSERDA – New York State Energy Research and Development Authority

NYSGS – New York State Geological Society

ORRB – Operational Readiness Review Board

OSR – Operational Safety Requirement

PNL – Pacific Northwest Laboratory

PVS – Permanent Ventilation Unit

QA – Quality Assurance

QAP – Quality Assurance Program

QC – Quality Control

RCRA – Resource Conservation and Recovery Act

SAR – Safety Analysis Report

SI – International System of Units (metric)

SPCC – Spill Prevention Control and Countermeasures

SPDES – State Pollution Discharge Elimination System

STS – Supernatant Treatment System

TLD – Thermoluminescent Dosimeter

TRU – Transuranic

USGS – U.S. Geological Survey

VF – Vitrification Facility

WNYNSC – Western New York Nuclear Service Center

WVDP – West Valley Demonstration Project

WVNS – West Valley Nuclear Services Company, Inc.

ABBREVIATIONS FOR UNITS OF MEASURE

Radioactivity and Dose

Symbol	Name
Ci	curie
mCi	millicurie (10 E-03 Ci)
μCi	microcurie (10 E-06 Ci)
nCi	nanocurie (10 E-09 Ci)
pCi	picocurie (10 E-12 Ci)
fCi	femtocurie (10 E-15 Ci)
aCi	attocurie (10 E-18 Ci)
Bq	becquerel
Sv	sievert
Gy	gray

Volume

Symbol	Name
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
ppm	parts per million
ppb	parts per billion

Length

Symbol	Name
km	kilometer (10 E03 m)
m	meter
cm	centimeter (10 E-02 m)
mm	millimeter (10 E-03 m)
m	micrometer (10 E-06 m)

Mass

Symbol	Name
g	gram
kg	kilogram (10 E03 g)
g	microgram (10 E-05 g)
ng	nanogram (10 E-09 g)
t	metric ton (or tonne; 10^3 kg)

Time

Symbol	Name
yr	year
d	day
h	hour
m	minute
s	second

Area

Symbol	Name
ha	hectare (10,000 m^2)

CONVERSION TABLE

Multiply	By	To Obtain	Multiply	By	To Obtain
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.454	kg	kg	2.205	lb
liq qt	0.946	L	L	1.057	liq qt
ft^2	0.093	m^2	m^2	10.76	ft^2
ha	2.47	acres	acres	0.405	ha
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.7	ft^3
dpm	0.450	pCi	pCi	2.22	dpm
nCi	1000	pCi	pCi	0.001	nCi
pCi/L	10 E-09	Ci/mL	Ci/mL	10 E09	pCi/L
pCi/m^3	10 E-12	Ci/m^3	Ci/m^3	10 E12	pCi/m^3
becquerel	2.7 x 10 E-11	curie	curie	3.7 x 10 E10	becquerel
gray	100	rad	rad	0.01	gray
sievert	100	rem	rem	0.01	sievert
ppb	0.001	ppm	ppm	1000	ppb
ppm	1.0	mg/L	mg/L	1.0	ppm

TABLE OF UNIT PREFIXES

Factor	Prefix	Symbol
10 E09	giga	G
10 E06	mega	M
10 E03	kilo	k
10 E-02	centi	c
10 E-03	milli	m
10 E-06	micro	μ
10 E-09	nano	n
10 E-12	pico	p

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Public Information - WVNS

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